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TELEPHONE ENGINEER

VOLUME 28 JUNE, 1924 NUMBER 6

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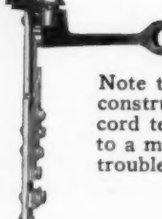

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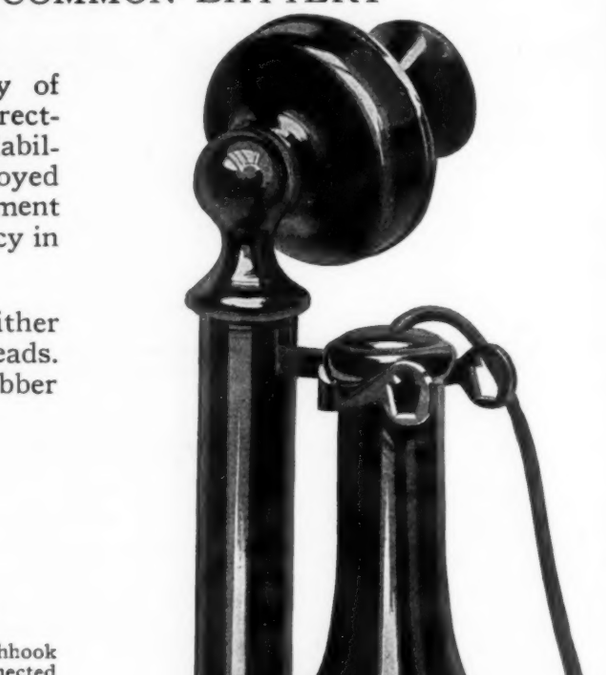

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STRAIGHTFORWARD TRUNKING

In the February number of this journal appeared the first story that has been printed in a periodical of general circulation about the new method of trunking between manual offices, termed "straightforward trunking." In this issue we present a paper by John P. Boylan, vice-president and general manager of the Rochester Telephone Corporation, describing the development of this system and its trial application in the plant of that company.

Trunking methods in manual offices have not changed materially in the last twenty-five years. Telephone men seemed accustomed to think of the order-wire method of operation as the last word in manual trunking, beyond which it was not possible to go. Of course, far-seeing operating men knew the disadvantages of that system and looked forward to the day when something better might take its place, but there seemed little hope that their dreams would be realized.

Now, it appears that we have a possibility of superseding the system by one of manifest advantages. The idea of straightforward trunking is not new—in fact, it probably is as old as trunking itself. But only in recent years has the equipment art reached the point where its practical application seemed possible. Many things had to be learned about switching methods before a workable system could be developed.

All of this goes to show that there is nothing static about the telephone art. Practices that have been established for many years must pass out of use to make way for improvements. The end is not yet in sight. The problems that face the telephone engineer are just as difficult and present fully as great opportunities in their solution as those of the past. Just as Hayes, Scribner, Dean and others arose to develop the common battery switchboard and Strewger, Keith and their associates to develop the automatic, so will new men come forward to solve the new problems and to write their names in telephone history.

Incidentally, the story of the work of Mr. Boylan's company in collaborating with the manufacturer in the development and trial of the new system shows what can be accomplished when manufacturer and operating company join forces to solve an equipment problem. It is this sort of co-operation for which we were pleading in our editorial in last month's issue.

ANOTHER TELEPHONE BY-PRODUCT SERVICE

The announcement of the successful transmission of photographs by wire gives reason to believe that the telephone system of the country may become the principal agent for transmission of news photographs. At the present time, when a big news story "breaks" on the eastern coast of the country the story is carried by western coast papers almost as soon as in the papers in the locality where the event occurred. The same thing is true between all other parts of the country, regardless of the location of the story and the newspaper. At present, however, only the newspapers which are situated within a few hours by train are able to reproduce photographs while the story is fresh. The other papers can show the pictures several days later but by that time interest has waned.

To a limited extent, the newspapers have used a system of transmitting telegraphic code messages which gave information from which the picture could be reproduced. The newly invented system by telephone wires, is, however, direct transmission, just as the telephone is direct transmission of voice. In the new system, the current is controlled by the values of light and shade of the film, just as the voice current is controlled by the variation of vocal sound. This later system would seem to be much less likely to be subject to errors of transmission and reproduction.

The obvious channels for transmission of photographs are the wire lines of the country. Transmission by radio has its appeal to the imagination and may be possible from a technical standpoint, but difficulties due to interference and extraneous signals would, in all probability, prevent successful application. Naturally, the long distance companies are interested as this form of service may become a profitable additional service that can be rendered by existing plants. Perhaps, in a few years, we may be transmitting not only simultaneous telephone and telegraph signals over one set of conductors but transmitting photographs as well.

"The maintenance of correct public relations is dependent upon consistency, insistency and persistency in telling all the people the whole truth about your business."—W. P. Strandborg.

"IT DOESN'T MEAN ANYTHING"

A short time ago in one of Rube Goldberg's comic strips there appeared a set of cartoons of the man who kept getting the busy signal when he called a certain number. Finally in disgust he put on his hat and went to find out if the line really was busy. When he arrived at the address he was informed that the telephone was taken out six years before.

We have been in the telephone business for considerably more than six years, and we think we are in pretty good position to guess what actually happened. Our guess is that the irate subscriber got the telephone number from an old letterhead instead of from the current directory, and that the telephone number had been re-assigned about five years and six months previously to a flat rate station in a boarding house or a pool room.

No doubt, the greater number of newspaper readers of the type that revel in the "funnies" saw some humor in the cartoons and in the aspersions cast on the operators. As for these hard-working young women, it is probable that their ideas would well be expressed by the legend over the comic strip: "It doesn't mean anything."

THE VALUE AND THE COST OF SERVICE

An editorial in a daily paper that came to our attention a short time ago, contained the following statement: "In public utilities like the telephone, cost of service has long been recognized as the rate making criterion. The value of the service to the subscriber does not concern rate-making authorities."

On this point we must take issue. There is no question that the value of service may be of material importance in rate making. Utility commissions have realized this and they have been quick to take it into consideration in the few cases where rate levels approached the value of the service.

Unfortunately for the utilities, this consideration has not been given in many cases where the value of service is much greater than the cost. If it had been, the utilities would have been treated more liberally, and the rate of return would not have been placed at the lowest point possible without being adjudged confiscatory.

PUBLICITY AS AN ENGINEERING FUNCTION

In the constant work for the betterment of public relations telephone companies are learning that the publicity given the achievements and study of their engineers brings a favorable reaction difficult to beat.

There is the background of specialized training and professional ethics that the public mind has absorbed, which gives a tenor of unassailable accuracy to the engineer's statements.

From the editorial point of view "copy" from the engineer of today has not only accuracy but a lively appreciation of the quality of human interest. As a model of commendable publicity work from an engineering source, a page in a recent issue of a Fort Wayne, Ind., newspaper, might well be chosen.

The article is headed "Fort Wayne of Tomorrow in the Light of Yesterday," and presents a forecast of the city's future based upon past performance. Plentifully illustrated by charts, and replete with statistics vital to business growth, all handled in an interesting manner, the page is one that must be of practical education to the studious business. The article was written by E. L. Gaines, traffic superintendent of the Home Telephone and Telegraph company.

He writes:

"The dreamer dreams dreams and builds castles in the air; the prophet and the seer foretell the future through inspiration, occultism and theosophy; the astrologer consults the wisdom of the stars to forecast oncoming events and predict the future course of human destiny, but the hard-headed business man of today assembles the records of the past with the present, tabulates all authentic information available and accurately predicts a future upon which he spends hard cash, and thus makes that future possible and actual.

"The realization of the accomplishment of his prediction is largely the outcome of his own effort, for without his foresight and his faith and courage to act thereon in a tangible way, not only his own advance would be stopped but the progress of the community as a whole would be handicapped.

"It is not the dreamer who makes possible the greater city of tomorrow. It is the cool, calculating business man, aided by his corps of engineers and accountants and every latest method and device known to modern business and science. It is true the business man must also be a dreamer. He must be a seer in the finest sense of the word, but he dare not be ruled by his dreams.

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Improved Manual Trunking

A Story of Development of Straightforward Trunking Methods and Equipment—Elimination of the Call Wire and Addition of Other Features Make Faster and More Accurate Service Possible

By JOHN P. BOYLAN*

Vice-President and General Manager Rochester Telephone Corporation

When we speak of invention of the telephone, we are inclined to think of the complex and marvelous art as we know it today, rather than the crude single pole receiver that Bell gave to the world in 1876. As wonderful and mysterious as was Bell's invention, it would have remained hardly more than a scientific toy, but for the essential contribution to the art that soon followed, which placed the telephone on a par commercially with its older brother—the telegraph.

It was realized from the first that some switching scheme was needed whereby the lines in a given locality or exchange could be connected to each other. The switchboard used by the telegraph companies at that time consisted of brass bars placed at right angles to each other and separately insulated on a wooden frame. Each line was fastened to a bar and by means of metallic pegs inserted at the junctures of the brass bars, any two lines could be connected together. With comparatively few changes, this type of switchboard was readily adapted to telephone use, and for a long time it held its own against the many switching schemes designed to replace it.

The Switchboard Preceded the Transmitter

Thus, the switchboard, though crude, was developed to a fair degree of dependability before a suitable transmitter was brought out. As the talking part of the telephone was the receiver alone, it was, of course, necessary for the user to move the instrument alternately from his lips to his ear. This was rather confusing, especially to new subscribers, and in order to aid them in using the telephone correctly, the following notice was usually placed near the set: "Don't talk with your ear or listen with your mouth." With the advent of the carbon transmitter, the business received a great impetus and the peg switchboard was soon found altogether inadequate to take care of the rapidly growing number of subscribers. The first radical change in the peg type switchboard was the replacing of the cross bars with jacks, and the pegs with plugs attached to long cords.

*Paper read at Up-State Convention of New York.

Owing to the fact that the jacks were rather large, and that even more space was occupied by the line drops, the number of lines that could be placed within an operator's reach might be only a very small per cent of the total number of lines in the exchange. Therefore, operators at that time did not sit at any particular location at the switchboard, but walked back and forth with long cords, putting up and taking down connections from one end of the board to the other. The noise and confusion of a fair sized central office of those early years are hardly conceivable when we think of our quiet and orderly operating rooms of today.

An editor, commenting on his visit to the Chicago exchange in 1879, said: "The racket is almost deafening. Boys are rushing madly hither and thither, while others are putting in or taking out pegs from a central framework, as if they were lunatics engaged in a game of Fox and Geese." "A perfect Bedlam" was how E. J. Hall described his exchange of twelve boy operators in Buffalo at about the same time. From two to six operators were needed to handle each call. In Chicago all calls were received by boys who repeated them through a speaking tube to the operators; while in another city, a boy received the calls, wrote them on white marbles and rolled them to the boys at the switchboard.

Everyone was called by name—there being no number system. Even as late as 1880, when New York City boasted 1,500 telephones, names were still in use. With the ever increasing number of subscribers, the switchboard and traffic methods were forced to undergo revolutionary changes, and the first of these was the multiple type switchboard, in which all the subscribers' lines are within reach of each operator. This was a decided improvement on the old board, for it enabled each operator to complete her own calls with consequent saving in number of operators and reduction in errors.

About 1896, the central battery system was inaugurated, and this was perhaps a greater change than all of the previous changes combined. This new system made it possible to do away with the wet batteries and the cumbersome magneto generators at the subscribers' stations. It enabled the large line drops to be replaced with tiny lamps, and in fact there was hardly any part of the accepted standard practice that was not affected.

Automatic Grows Up Alongside of Manual

Other important improvements followed in switchboard design and methods, and the art gradually divided in two schools or branches: Those who continued to develop manual equipment and those who took up the development of automatic, or as it is called today "Machine Switching" systems. Manual switchboards were soon fairly standardized by engineers and manufacturers, and no radical changes took place for several years. Switchboards of 10,000 lines capacity have been the practical limit for some time, and there is little indication that larger single units are ever advisable. Aside from the limiting factors of the equipment itself, there are economic reasons in regard to the outside distribution of cables that make it desirable to establish more than one central office in a given district when the total number of lines will equal or exceed 10,000. This brings about the necessity for inter-office trunking, of which there are two general methods: The first is called two-way trunking, and, as the name implies, employs trunks that can be used for handling calls between central offices in either direction. The other method uses one-way trunks which carry traffic in one direction only, and as this is the system almost universally used for multi-office trunking, it will be described.

Present Manual Trunking Practice

The outgoing ends of the trunks are on jacks just below the subscribers' multiple, and are arranged in a similar way—that is, they repeat in each section so as to be available to every "A" operator. Each group of trunks to a given office is designated by the name of the office and the trunks are designated by numbers which correspond with the numbering at the other, or incoming end.

The incoming end of the trunks terminate on separate positions from the regular subscribers' switchboard. The

trunk positions are usually called "B" positions, to distinguish them from the "A" positions at which subscribers' lines terminate. The trunks terminate at the "B" positions on cords and plugs associated with supervisory lamps, and ringing keys much the same as in a regular local position, except that they are in one row and closer together, as there are from 30 to 40 in a position. They are designated according to the office from which they come, and as stated, are numbered the same at both ends.

The "B" operator's telephone set is not connected in any way with the trunk circuits, but separate lines known as order wires are used to pass orders between "A" and "B" operators. Each "B" operator's telephone circuit is permanently connected to an order wire which terminates on push button keys at the "A" positions in the other offices of that exchange group.

Assuming an "A" operator answers a call for a number in another office, she presses the order button designated by the name of the office desired, and this act immediately connects her telephone set with a "B" operator to whom she passes the number and the name of her own office. The "B" operator then knows from which group of trunks to assign, and gives the "A" operator the number of an idle trunk in that group; at the same time testing the line called for, to determine if it is busy. If not, she inserts the plug and presses the proper ringing key button, the guard lamp going out at the same time.

The "A" operator in the meantime has connected her subscriber to the outgoing trunk jack assigned to her. When the conversation is finished, and the subscriber hangs up, the supervisory lamp of the answering and calling cords will light, but the guard light at the "B" position will not be displayed until the connection is taken down at the "A" end.

Should the number called for test busy, the "B" operator then inserts the plug of the trunk she has assigned on that call into one of a small group of jacks known as "busy back jacks." This will cause the supervisory lamp of the calling cord in that trunk to flash —thus notifying the "A" operator of that condition. If the calling subscriber has not recognized the clicks, and in some cases a tone, and hung up, he is told by the "A" operator that his called number is busy.

While this trunking method gives speedy operation, it introduces chances for errors that attempts have been made for several years to eliminate or reduce. In nearly all the modifications heretofore proposed, there was usually a compromise between speed and accuracy, in other words, these schemes, while reducing the possibilities of errors, increased the holding time considerably, as compared with this older method.

Straightforward Trunking a New Development

Recently a trunking system has been developed by the engineers of the Stromberg-Carlson Telephone Manufacturing Company and the Rochester Telephone Corporation, which approaches the desired requirements as to load possibilites and accuracy. This system is a modification of the straightforward trunking method which has taken various forms and is replacing the older order wire system in different parts of the country.

The outstanding features of the straightforward method in any of its modifications, as compared with the other system, are that the "A" operator selects her own trunk and talks directly to the "B" operator on the trunk used for the subscriber's connection. This gives the two operators an exclusive circuit without interference by other operators.

The first method tried out, while tending to reduce errors, was rather slow and cumbersome. It is known as "Stage 1" and called for only slight changes in the equipment—the principal change being in the method of operation. Two listening jacks are provided at each "B" position, and wired to the "B" operator's telephone set.

The "A" operator receiving a call for another office, plugs into an idle outgoing trunk jack which causes the guard lamp to light at a "B" position in the office selected. The "B" operator takes up the plug of the trunk and inserts it in one of the listening jacks, which puts her set across the trunk; at the same time sending back a momentary order tone to the "A" operator, which is a notification for her to pass her number. After acknowledging with "Right," the "B" operator removes the plug from the listening jack and tests the jack of the line called. If it is busy, she disposes of the plug in a busy back jack, the operation of which is the same as in call wire method. If the line is not busy, she inserts the plug and rings in the regular way. The disconnect signals operate in the same way and order as they do in the other method. Incoming calls and disconnect signals are both indicated by the guard lamp burning steady, the operator distinguishing one from the other by noting whether the corresponding cord is up in the multiple or not.

To reduce the amount of testing for idle trunks by the "A" operator, the outgoing trunk multiple jacks are divided into groups and marked to indicate the jack each operator is to start testing.

The disadvantages of "Stage 1" are that it is quite slow and introduces complexities not met with in the call wire method. For instance, some means must be provided to keep the busy test on an outgoing trunk jack after the "A" operator has disconnected, since she gives the disconnect signal to the "B" operator, and the trunk is, therefore, always up for a while after the outgoing end has been released. It is rather expensive to provide a busy test on the outgoing trunk jacks that can be controlled by the position of the plugs at the incoming end, so that this is rarely ever done, it being considered that the time lost and inconvenience to the traffic by an operator occasionally plugging into a trunk that has not been taken down by the "B" operator, hardly warrants the cost of this special feature.

The same is true of a trunk in a busy back jack, though the lost time is not so long, since an "A" operator plugging into a trunk still up in a busy jack, will get the characteristic sound and will go on to the next jack. The principal objection to this stage, however, is its rather small load possibility. In order to bring up this factor and overcome certain other traffic irregularities, some changes were made in the equipment and circuit. This modification was known as "Stage 3," and differs from the other stages in that the "B" operator's telephone set is automatically cut in on a trunk, and the signals are now readily distinguished, all tending to make for quicker operation. The testing time at the outgoing trunk multiple is also cut down by the provision of what is known as "master busy test feature." The group of jacks that each operator is supposed to test first are so arranged that when all the jacks in that group are busy, a special tone is put on the first jack, so that an operator testing this jack will know that the next five or ten trunks, as the case may be, are busy and will go to the next group. This stage provides against an "A" operator taking a trunk remaining in a subscriber's multiple jack, or a busy jack at the "B" board, by maintaining a busy test at the outgoing end until the trunk is actually taken down by the "B" operator.

Busy lines are indicated to the "A" operators by means of busy back jacks, the same as in the previous methods. Incoming trunk calls are displayed by the guard lamp burning steady, and are automatically cut in on the "B" operator's telephone set, one at a time, in a definite order, though this may not be always in the sequence that the calls came in. The guard lamp flashes while the trunk is connected to the operator's

telephone set, indicating to her which one to pick up.

Story of Development of the New Method

This was the status of straightforward trunking at the time we decided to take it up for study and further development with the Stromberg-Carlson Telephone Manufacturing Company, in the Fall of 1923, and a subsequent development described represents the work of engineers of the Rochester Telephone Corporation and the Stromberg-Carlson Telephone Manufacturing Company.

The first few weeks were devoted to collecting what data on the subject were obtainable, and setting up experimental apparatus in the laboratory. The final laboratory set-up consisted of the equivalent of a "B" position equipped with twenty automatic cut-in trunks and the corresponding outgoing jacks. The rapidity and accuracy with which calls could be handled were easily demonstrated by this experimental layout. There are, however, certain objections to the automatic cut-in feature, from equipment and operating viewpoints, which may be summarized as follows:

1—The automatic cut-in apparatus is common to all the trunks in the position, to a more or less degree, so that any trouble occurring with this part of the system is liable to affect, and probably put out of order, a small or large group of trunks depending on the nature of the trouble.

2—Since the incoming calls are cut in on the "B" operator's telephone set in a fixed order, such as from left to right, and since the order in which the calls come in cannot be regulated accordingly, it is evident that during the light load period some of the calls will be held up by the others coming in the proper rotation to be answered first.

3—Considerably more equipment is required to provide this feature, which adds to the complexity of the system, as well as to the cost and maintenance.

With a view to simplifying the trunk circuit and overcoming the objections of the automatic cut-in feature, it was suggested that the cutting in of the operator's telephone set be controlled by the operator, by means of a small push button key associated with each trunk. The trunk circuit was accordingly redesigned to operate on this basis, and it seemed sufficiently promising to warrant a trial in actual practice. A "B" position in our Glenwood office was therefore equipped with 40 of the new trunks. During the period of installation, changes of more or less importance were made, so that when the trunks were cut into service a few weeks later, the method of operation was briefly as follows:

An Experimental Installation

A group of forty trunks from the main office was chosen for the trial. The outgoing trunk jacks of this group in the main office were especially marked to distribute the load among the 60 "A" operators as evenly as possible, and at the same time reduce the amount of testing. No master busy test feature was provided, since it was felt that the group was hardly large enough to warrant it.

On receiving a call for a Glenwood subscriber, the main operator tests the first jack of her preferential group. If it is not busy, she inserts her plug, which starts the guard lamp of that trunk flashing. The "B" operator, noticing the flashing guard lamp, presses the cut-in-button directly in front of the guard lamp, which puts her set across the trunk, sends back momentary order tone, and changes the flashing lamp to steady dim. The "A" operator, hearing the tone, passes her number, which the "B" operator acknowledges by saying "Right," and at the same time picking up the plug of the trunk and testing jack of the line called. If it is disengaged, she makes the connection and presses one of her master ringing buttons corresponding to the party designation called. This releases her set from the trunk, starts the ringing and extinguishes the guard lamp.

During the ringing intervals, a reverting tone is sent back, indicating to the calling subscriber that his party is being rung. The ringing feature used with this system is radically different from the usual arrangement in which each trunk is equipped with a set of four party ringing keys, since the equivalent of only one such set of keys is provided for the entire group of trunks in each position. A fifth key is used to release the operator's set on calls requiring no ringing, such as lines to intercepting desks, supervisors, etc. The set of five keys is centrally located in the key shelf, and at right angles to the conventional arrangement of ringing keys. This is one of the principal features of this system. It was developed by the engineers of the Stromberg-Carlson Telephone Manufacturing Company a few years ago, in connection with their super-service switchboard, and slight modifications in this ringing scheme, fitted in admirably with the straightforward trunking. This feature, perhaps, more than any other, makes possible the speed and greater accuracy of Stage 3, using the automatic cut-in. The trunk holding time was further reduced and the operation simplified, by making the trunk immediately available, upon the "A" operator taking down the connection, regardless of whether the "B" operator has pulled down the trunk or not. In either case, if the trunk is again taken, the guard lamp will start flashing. If the trunk is in a jack, the "B" operator must pull it down before she can cut in on it.

A special busy test for the outgoing trunk multiple controlled from the incoming end is, therefore, unnecessary in this system. At first, busy back jacks were used to notify the "A" operator that lines called for were busy, but after this method had been in use a short time, it was observed that occasionally an "A" operator would plug into a trunk that had just been released by another "A" operator on a busy back signal, but which had not yet been removed from the busy back jack by the "B" operator. The "A" operator getting the busy back signal would, of course, pull out and go to the next jack. This necessarily slowed down the "A" operator and increased the trunk holding time.

In call wire operation, busy back jacks are necessary, as the "B" operator must then have an indication of the trunks that are giving busy back signals, so that she will not assign them until they are released by the "A" operator. With straightforward operation, however, this is unnecessary, since the "B" operator in this case does not assign trunks. This enabled a departure to be made in the usual busy back jack scheme that greatly simplifies this part of the operation, and overcomes the possibility of an "A" operator taking up a trunk on which there is a busy back signal.

This was accomplished by substituting a common busy back key for jacks, and arranging the circuit so that as soon as the "A" operator removes her plug from a trunk on which there is a busy back signal, the circuit will be normally restored and available for another call. After the "B" operator presses one of the busy back keys, there being one located at either end of the key shelf, her set is released from the trunk, the guard lamp is extinguished, and she has to give it no further attention.

Some New Features Are Developed

The next important step was the provision of a splitting feature to prevent traffic collision and give the called subscriber's line immediate disconnect, and line lamp recall upon the "A" operator taking down the connection. If an "A" operator, therefore, takes a trunk that has not been removed from a subscriber's line, she will not find a party waiting to get his operator, as frequently occurred before this feature was provided.

An emergency listening jack, and a few releasing jacks, are provided for each "B" operator's position, so that if she is unable to cut in on a trunk in the regular way, she can plug into the emergency listening jack and learn the number desired. Should she have difficulty in obtaining a number, or for any other reason she wants to temporarily dispose of that trunk, she does so by plugging it into one of the releasing jacks. The traffic study shows that there is a marked improvement in the calls handled by this system, the errors being reduced at least fifty per cent, with the operator's load maintained as high as with the order wire method. The trunk efficiency is also increased by at least ten per cent, which is a considerable item, especially in congested trunk groups.

As stated before, the outgoing trunk multiple of this experimental group was not changed as far as the equipment was concerned. The jack marking minimized the testing sufficiently to make any further changes unnecessary. For the larger trunk groups, however, means, in addition to preferential jack-marking, must be provided to cut down the testing time. The simplest scheme is the master busy test described under Stage 3. A visual master busy signal, while adding some complication to the system, would seem to provide the most desirable arrangement from a traffic viewpoint, especially for the larger trunk groups. Since less than fifty per cent of the outgoing trunk multiple jacks used in call wire operation is required in straightforward trunking, a substantial saving is made in this portion of the equipment, and incidentally sufficient space is thus provided for master visual signals when required. This part of the problem is still a matter of discussion among traffic and equipment engineers, and just what the ultimate scheme for the outgoing trunk multiple will be is difficult to predict at this time.

A new switchboard is now being built by the Stromberg-Carlson Telephone Manufacturing Company for our new Culver Exchange, to be located in the northeast section of the city. It is expected that this exchange will be cut into service about February 1st next. The switchboard will be the last word in manual improvements and innovations, and will embrace all of the super-service features, as well as the straightforward trunking system.

The super-service features already described on the "B" keyboard, in connection with the straightforward trunking, such as the absence of ringing and listening keys, the automatic connection of an answering cord to the "A" operator's set when such cord is placed in the answering jack, and the automatic disconnection of the operator's set as soon as the ringing selective is made, automatic ringing, automatic busy signal, both on local and trunked calls, operator's secret service and many others which the time allotted to me will not permit of describing in this paper.

Structural Details of the Switchboard

A distinctive feature on this board will be an arrangement whereby the operators can use low chairs without the necessity of providing a platform in front of the switchboard.

The keyboard will be placed thirty inches from the floor, or about the height of an ordinary desk. This enables the operators to use low chairs with their feet on the floor, and to dispense with the usual foot rail. The usual keyboard height for a board of this size is approximately forty inches, and in some cases platforms have been provided to reduce this height. In this board, owing to the removal of all apparatus to the terminal room, the only requirement for a greater height than thirty inches was the space allowance for the cords and cord weights. This space will be obtained by placing a trough approximately ten inches deep in the floor of the operating room at a point immediately below the cords, and arranged to allow the cord weights to extend into it. This trough extends below the floor for the length of the operating room, and is arranged for the ultimate length of the board. The trough is covered by a removable two-inch oak cover over the portions not in use, and the linoleum floor covering laid over it. On making additions to the switchboard, the trough will be available by removing the cover and linoleum. This arrangement allows the keyboard to be kept at a convenient level, without the use of platform or similar means, and enables the operating room floor level to be established when the building is constructed.

The fire risk in a board of this type is reduced to a very low point by placing the relays and structural aparatus in the terminal room, and this risk is further minimized by a system of fire screens and bulk heads. The multiple shelf is extended from the front of the board to the rear panels, the rear portion of this shelf consisting of removable screens. These screens, which are normally in place, are arranged to be readily removed when necessary to work on the board. The board is further separated by sheet iron bulkheads placed every two sections, and are arranged to allow the installation of the entire multiple and trunk capacity, the space required being closed by removable panels. The net effect of these screens and bulkheads is to confine the fire.

Blind Youth Is Operating Genius —Learned in Three Hours

South Solon, Ohio.—William Neer, blind telephone operator of South Solon, handles one hundred telephones with more ease and success than many hello artists with two good eyes.

When young Neer, who is just 21, was six years old, he was struck in one eye with a stone. Medical science then failed to save the sight and infection later blinded the other eye. He was unable to find work that was fitted to his ability until persuaded to attempt the operation of a modern telephone switchboard. He mastered the board in three hours and when the telephone executives heard of his remarkable ability, they made him the chief operator of the switchboard in his home town.

Wm. Neer, Blind Operator at South Solon, Ohio

Neer knows every one of the hundred calls by sound and his long, slender fingers manipulate the cords, plugs and keys of the switchboard with lightning-like rapidity and with unerring accuracy. When a call comes in, the shutter drops and before it appears possible the tips of the blind youth's fingers have found the right place on the switchboard and the parties are connected.

He is familiar with each separate phone in the exchange and knows every section of the Kellogg board so well that there is no delay in the calls. During his five years as operator, he has mastered by consistent hard work the local as well as the long distance calls and is able to handle with ease both at the same time. He is perfectly satisfied with his lot since he has found something to do to keep his hands and mind busy. He is an accomplished musician and owns an orchestra of which he is leader and pianist. He is giving such satisfaction in his telephone work that it is held probable that he will continue for many years.

Long Lines with Repeaters

Some Technical and Economic Features of the Application of Repeaters to Long Distance Lines Are Discussed Herein—Also Something of Cross-Talk and Balancing of Cable Pairs

By F. J. Dommerque and Dr. K. W. Wagner*

The three-electrode electron tube with a high vacuum forms the basis of the modern purely electric repeater. There are two ways of connecting such repeaters to the long distance lines; they may be inserted at certain fixed points along the line, or they may be provided with plugs and made part of the toll operator's cord-circuit, so as to

FIG. 1

enable her to connect them to any of the long distance lines according to requirements. The most practical arrangement is to locate open-wire line repeaters in telephone offices and cable line repeaters in special buildings.

Repeaters of this type work in one direction only, and as it is essential for telephone communication to talk both ways some arrangement is necessary to effect two-way operation. One way in which this can be done is by using two lines, each of which contains a repeater, the repeaters being so arranged that the repeater in the one line works in one direction and the repeater

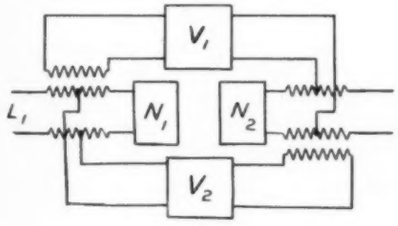


FIG. 2

in the other line in the opposite direction. This arrangement is called a 4-wire circuit. Another method is by using one line only but inserting in the line two repeaters in parallel, one of which works in one direction and the other in the opposite direction as shown in Fig. 1. The arrangement indicated in Fig. 1, however, is not practical, because the currents, after having passed from line L_1 through repeater V_1, would act also upon repeater V_2, where they would be still further amplified and fed into V_1, thus setting up a continuous circle of amplification producing "singing." To prevent this the repeaters are connected to the lines by means of a bridge, Fig. 2, formed by a differential transformer in conjunction with a balancing network (N_1 and N_2) consisting of resistances, inductance coils and condensers. It is of the greatest importance that over the frequency range from 200 to 2200 cycles per second or more, over which the repeater operates, the impedance of the network approaches to a fairly high degree the impedance of the line it has to balance.

The 4-wire circuit can begin at one toll-board and extend to a distant toll-board with a number of repeaters in tandem; in this case the 4-wire circuit would be connected at both ends to 2-wire (subscriber's) lines as shown in Fig. 3. In this arrangement, however, the total amplification in the 4-wire circuit must remain less than the total attenuation, to prevent self-vibration. No difficulty is met when connecting the four-wire circuit at both ends to 2-wire circuits by means of a bridge consisting of a differential transformer and a balancing network like that shown in Fig. 2.

The 4-wire circuit requires twice as many wires for a connection as the 2-wire circuit, but in the 4-wire circuit are fewer transformers and balancing networks. Consequently it has less losses. Investigations made by the engineering department of the German Postoffice have shown that for the same type of tube an amplification in the 4-wire circuit may be reached of $s = 3$ to 3.5, and in the 2-wire circuit of $s = 1.6$ to 2.2 according to the degree of balance. The higher degree of amplification in the 4-wire arrangement permits the use of smaller line wire. From calculations made by the above mentioned engineering department pertaining to the economy of the two repeater arrangements in their application to large size long distance cables, the curves in Fig. 4 have been plotted. The ordinates of the curves represent the cost of operation of a long distance line equipped with repeaters, the unit of cost being taken arbitrarily. The abscissae give the diameter in millimeters of cable conductors (copper) for which the costs have been calculated. The purely cable expenses (interest and amortization of capital invested, cable maintenance; curves K)

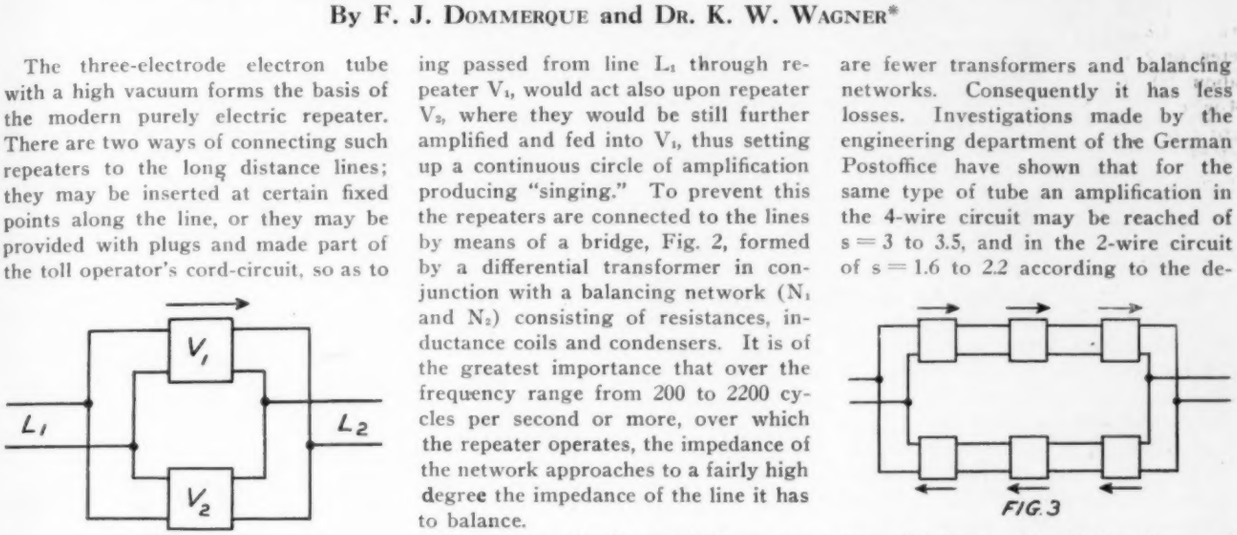


FIG. 3

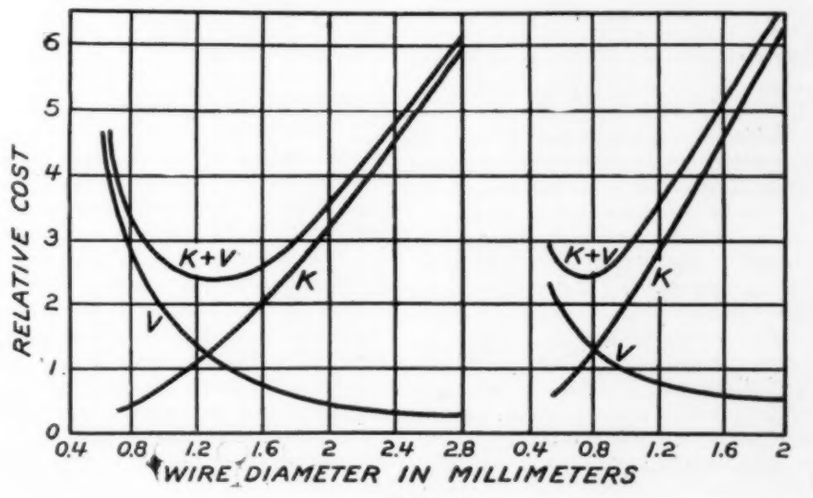


FIG. 4

* Second and final instalment.

increase with increasing diameter of conductor, the operation expenses of the repeaters (interest and depreciation, tube-renewal, attendance, rent and sundry expenses; curves V) decrease with increasing conductor diameter, because the larger conductor attenuates less and consequently requires fewer repeaters. The curve of total cost K + V attains a minimum between 1.2 and 1.4 mm conductor diameter for 2-wire circuit operation and at about 0.8 mm conductor diameter for 4-wire circuit operation. 1.2 to 1.4 mm corresponds to No. 16 B & S. G. wire (1.291 mm) and 0.8 mm to No. 19 B. & S. G. wire (0.899 mm).

Length of Line for Economical Operation of Each Type

Investigating lines of different lengths, the conclusion has been reached that for distances up to 900 km (550 miles) 2-wire operation over 1.4 mm (No. 16 B. & S. G.) conductors is most economical, and for greater distances 4-wire operation over 0.9 mm (No. 19 B. & S. G.) conductors. In view of the results of these investigations the German Postoffice selected the two types of cable, the one with 0.9 mm conductors and the other one with 1.4 mm conductors as the standard for its long distance cable lines. The conductors in the cables are arranged in pairs and are suitable for phantoming. The following table gives the electric properties of the cables:

Circuits	Number of Circuits			Loading Coil Inductance Henry	Wave Resistance $Z\sqrt{\frac{L}{C}}$ ohm	Attenuation Constant (km)−1	Limiting frequency $w_0/2\pi$ Periods per second
0.9mm physicals	38	58	126	0.20	1700	0.0210	2800
0.9mm phantom	19	29	63	0.07	770	0.0210	3500
1.4mm physicals	14	40	40	0.19	1600	0.0105	2800
1.4mm phantom	7	20	20	0.07	730	0.0105	3500
Total	78	147	249	Loading coil distance = 2 km. (1.2 miles).			

Taking for granted that a repeater in a 4-wire circuit can overcome an attenuation measure b = 3 and a repeater in a 2-wire circuit an attenuation measure b = 1.5 the figures in above table give the distance between repeaters as 150 km (90 miles) for the 4-wire circuit repeaters in the 0.9 mm cables as well as for the 2-wire circuit repeaters in the 1.4 mm cables. For short distances the 2-wire circuit of 0.9 mm cable is nearly equally economical as the 2-wire circuit of 1.4 mm cable.

Capacity Balancing of Long Distance Cables

Repeater lines require a high degree of balancing, certainly when the repeater lines are loaded. If the balancing in the bridges shown in Fig. 2 is imperfect the amplification can only be carried to a certain upper circuit, above which singing in the repeater is sure to take place.

Let Z_1 designate the complex impedance of line L_1.

N_1 designate the complex impedance of the balancing network L_1

Z_2 designate the complex impedance of line L_2

N_2 designate the complex impedance of the balancing network imitating L_1. then the relative unbalancing factors may be expressed as

$$\phi_1 = 2\frac{Z_1 - N_1}{Z_1 + N_1} \text{ and } \phi_2 = 2\frac{Z_2 - N_2}{Z_2 + N_2} \quad (1)$$

and the highest permissible amplification factor will be

$$S_m = \frac{1}{2}\log\epsilon\frac{1}{\phi_1\,\phi_2} = 1.15\log_{10}\frac{1}{\phi_1\,\phi_2} \quad (2)$$

As an example,

if $\phi_1 = \phi_2 =$	0.05	0.1	0.2
then S_m =	3	2.3	1.6

The difficulty to imitate a loaded line results from the circumstance that the wave resistance (impedance) of such lines is not represented by a smooth curve but by a more or less wavy curve. The least deviation from uniformity of the loading coils may cause these fluctuations, but non-uniformity of the cables would have a still greater disturbing effect. In both respects manufacturers have made wonderful progress in construction.

Loading coils and cables the inductances and capacities of which vary not more than from 2 to 3 per cent give a satisfactory smooth impedance curve.

A great step in advance was the introduction by the Western Electric Co. of compressed irondust cores in loading coils. Coils with such cores possess great magnetic stability.

Crosstalk

The circuits in a cable act upon each other by their electric and magnetic fields. The twisting of the conductors in a pair reduces this action in a high degree. Where cable pairs are phantomed, the physical circuits are also twisted. Loaded lines are coupled mainly by their electric field. The magnetic coupling is very weak as the principal part of the magnetic field lies in the coils.

Taking under consideration two circuits represented in Fig. 5 by the conductors a and b of one circuit and c and d of the other circuit, the electric coupling of these two circuits can be reproduced by partial capacities, x_1, x_2, x_3 and x_4. The partial capacities between the conductors of the same circuit (a, b and c, d) do not enter into this problem and may be left out. The partial capacities of the conductors to ground (here to the lead sheath and the remaining conductors) may be assumed as included in the partial capacities x_1 to x_4.

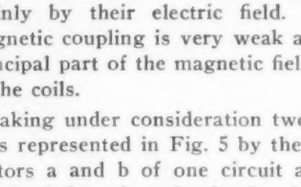


FIG. 5

The arrangement in Fig. 5 takes the form of a Wheatstone Bridge; equilibrium exists, if

$$\frac{X_1}{X_3} = \frac{X_2}{X_4}$$

in which case the electric coupling between circuit a, b and circuit c, d equals zero; there will be no crosstalk. As a rule, equilibrium is not complete; then the amount of crosstalk increases with the coupling between the two circuits. This increase is measured by the coupling capacity k, which is

$$k = k_1\frac{k_2 k_3}{4x} \quad (3)$$

wherein $k_1 = x_1 - x_2 - x_3 + x_4$ (3a)

$k_2 = x_1 + x_2 - x_3 - x_4$ (3b)

$k_3 = x_1 - x_2 + x_3 - x_4$ (3c)

and x = mean value of x_1, x_2, x_3 and x_4

To obtain a reduction in crosstalk, the coupling coefficients k_1, k_2 and k_3 must be reduced; the nearer the 4 partial capacities x_1 to x_4 equal each other, the more is the crosstalk reduced. In order to effect this reduction the cable

is divided into short sections which are constructed so as to make the coupling disappear for each piece of the cable between two coils. To obtain this end, each coil division must be subdivided, the coupling capacities of the several sections must be increased, the conductors in the sections must be joined together so that the capacity unbalance in one section counteracts the capacity unbalance in the section to be joined to it.

There are disadvantages embodied in this process. In the first instance there will remain some couplings that cannot be balanced. Second, the position of a certain line changes from section to section, which produces a non-symmetrical arrangement of conductors. Third, if a short piece of cable has to be replaced it will be necessary to rearrange the entire coil division and rebalance it.

Use of Balancing Condensers

To overcome these objections Siemens & Halske (Berlin) insert balancing condensers, which equalize the four partial capacities x_2 to x_4. Thereby all couplings disappear, as is shown by equation 3 to 3c. Three condensers are sufficient, which are connected in parallel to the three smaller partial capacities, thus bringing them up to the amount of the highest partial capacity. Each coil division requires only one set of balancing condensers. These condensers are accommodated in pots or splices located at the same place where the coils are inserted in the cable.

The amount of crosstalk is expressed by the attenuation measure of an artificial line, which when charged by the inducing voltage produces in a receiver of suitable impedance the same current as the induced line. Measuring with a receiver of high impedance, the coupling capacity k bears to the attenuation measure b/c of the crosstalk the relation

$$\epsilon\, b_c = \frac{2C}{k} \qquad (4)$$

wherein C represents the capacity of the disturbed line. Balancing by means of the condensers affords a reduction of the coupling capacities k practically to 10 micromicrofarad, of the coupling capacities k_2 and k_3 to about 50 micromicrofarad. Applying equation (4) to a coil division of 2 km (1.2 miles), it results for the physical circuits

$C = 0.072$ mf; and $k = \frac{1}{4}\, k_1$;

$b_c = 11$ (103 standard cable miles)

for the phantom circuit $C = 0.124$ mf; $k = \frac{1}{2}\, k_2$)

$b_c = 9.2$ (94 standard cable miles)

For the unbalanced cable the attenuation values of crosstalk amount to about 7.5 (70 standard cable miles) for the physical circuits and to 6.5 (61 standard cable miles) for the phantom circuit.

All this pertains to comparatively short cable lines. In long cable lines the attenuation measure or attenuation length of crosstalk may be reduced in the most unfavorable case by the amount $\log_e (n + 1)$ where n designates the number of repeaters. In long 4-wire circuits the greater amplification of the individual repeaters necessitates a separation of the outgoing from the return lines. Therefore it becomes advisable to position the outgoing lines in a part of cable cross section separated from the part in which the return lines are located.

The attenuation measure or length of a loaded line increases when the frequency increases and the increase becomes more pronounced when the limiting frequency is approached. In Fig. 6 two curves are plotted which

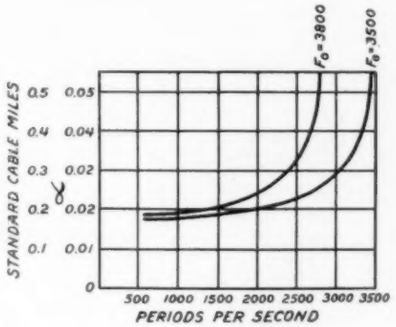


FIG. 6

give the attenuation curves for the physical and phantom circuits of a 0.9 mm (No. 19 B. S. G.) cable, the electric properties of which were tabulated above. The attenuation caused by the higher frequencies produces distortion of speech and as the attenuation difference increases in proportion to the length of line the speech finally becomes quite indistinct if repeaters are inserted in the line, which increase all frequencies uniformly. The best preventive measure is to keep the distortion in the line itself as low as possible. This requires a high limiting frequency, the longer the line the higher the requirements. In that respect phantom circuits are better adapted for talking over long distances than the physical circuits.

Increasing the limiting frequency reduces economy. Where the loading coil distance is fixed increasing the limiting frequency is equivalent to a decrease of the inductance load and a corresponding increase of the attenuation. To overcome this, repeaters are inserted. With increasing number of repeaters the economy of the line decreases and at the same time the operating reliability. All this shows that there are limits for the usefulness of repeaters in long distance cables, but where the limits are, can not be stated nor fixed by the experiences up to date. One thing is sure these limits have not been reached as yet.

Repeaters on Open Wire Lines

A few words may be said about the application of repeaters to open wire long distance lines. Here also the repeaters permit reduction of size of wire; but the gage cannot be reduced in the same degree as with cables for purely mechanical reasons, as the wires have to carry snow and sleet loads.

But it would not be economical to use repeaters on loaded lines as the loading coils would cost more than the saving through repeaters. But even if that was not the case, a non-loaded line has the advantage, because

1. It can be installed easier and much more accurately.
2. Its attenuation is less dependent on the frequency.
3. It has no limiting frequency.
4. Its distortion is consequently less.

Hillsboro (Ill.) Mutual to Spend $90,000 Extending

Hillsboro, Ill.—The Mutual Telephone Co., of Montgomery county has been granted permission to sell $90,000 worth of gold bonds to be used in extending and improving the lines of the company in this county.

The People's Mutual Telephone Co. serves 15 towns and employs 40 people. The permit to issue bonds gives permission to use this money for improvements in Hillsboro, Litchfield, or Nokomis, and the directors already have plans prepared for the installation of an automatic system, at Litchfield, which will cost about $39,000, and will require 12 or 15 months' work to install it. Improvements in other parts of the system are contemplated, to be put in later.

Indiana Bell to Take Over Interest Companies

Indianapolis, Ind.—The Indiana Bell Telephone Co. has asked the approval of the Indiana Public Service Commission to take over four telephone companies. The companies are the Citizens Telephone Co., Columbus; New Home Telephone Co., Linton; Indiana Telephone and Telegraph Co; Clinton and Parke County Telephone Co., Rockville. These companies have been controlled through stock ownership for many years but are now being incorporated into the larger company.

Pole Line Construction Tips

Being That Part of the Telephone System Which the Public Sees, High-Class Material, Methods and Maintenance Are Advisable—Importance of Proper Tools—Data Concerning Poles

By P. Kerr Higgins

In the preceding article most of the space was devoted to telephone pole lines. It is such an extensive subject that full justice cannot be done in one or two articles. In fact, an entire book would be needed to fully cover the subject. We can, therefore, only hope to touch briefly upon some of the more important features. The pole line includes the poles, cross-arms, pins, brackets, braces, guy wires, guy stubs, anchors and all other pole fittings and material.

It is comparatively easy to build a straight pole line, having no curves or corners; hence the test of good pole line construction is found in the manner of making curves, corners and crossings and in guying important points, where the load is abnormal. In order to insure uninterrupted service to the subscriber, it must necessarily be constructed in a substantial manner. Since the pole lines are most in evidence before the public, it is extremely important that all construction and maintenance of such shall be done in a workmanlike manner. To do this, three things are imperative: first, the proper tools should be available; second, the best material available should be used; and third, the best methods of construction should be utilized in every case.

In determining the best material for poles, the following is important. Strength, durability, elasticity, lightness, straightness and the ease with which it can be worked. The choice of wood must be determined by the individual and the funds or supply available. Cedar and chestnut are, by far, the most popular.

Characteristics of Various Woods

The following brief description of wood and its growth may be of interest to the reader:

"Wood is composed of minute cells in groupings of various kinds which have their special use in the life of the tree. Some of these conduct sap from the roots to the crown, some store away digested food, while others merely strengthen the structure of the wood and hold it together. In climates which have regularly one season of growth and one of rest, the cells of the layer of new wood formed each year are arranged according to a definite plan. The cells grown in the early portion of the year have large openings, allowing the sap more readily to pass up from the roots to the crown to be used in forming buds, leaves, and twigs. Later in the year, however, when the demand for water at the crown of the tree is not so great and more food supply is spared for building material, the cells are narrow and thick walled. Thus the summer wood in each year's growth is heavier, stronger and darker in color than the spring wood. As long as the tree is healthy and growing a ring is formed each year. The terms 'fine grained' and 'coarse grained' in part, refer to the width of the annual ring. The wood usually becomes darker and harder after it has been in the tree for some years and is usually referred to as the heart wood and is simply a frame work which supports the living parts of the tree. When the tree is cut down, the outer or sap wood rots more easily than the heart wood because it absorbs water more readily and contains plant food, hence the decay which is noticeable on the surface of poles. Trees are divided into two classes, broad leaved and needle leaved. The woods are usually referred to as hard woods in the broad leaved class, while the needle leaved trees are known as soft woods, the former being heavy and the latter light in weight and not so flexible or strong. The latter also has a regular structure, dry and shrink more evenly; therefore, suffer less from shrinkage cracks in seasoning. In the former class belong the chestnut and locust, while in the latter class belong the cedars and pine."

The desirable characteristic of the telephone pole is its durability and its ability to resist decay which is measured by the depth to which the decay penetrates each year. Wood is destroyed by what is known as fungi which requires food for their growth and development in addition to heat, air and moisture. If the fungi can be deprived of these elements, then the destruction of timber can be prevented. Seasoning for the time being reduces or eliminates moisture, but this can not be done entirely. In addition to seasoning therefore, we must add special treatment of some kind of which there are several kinds in use. This treatment may be applied to the butt of the pole only, as this is the part most liable to decay or, as in the case of pine poles, to the entire pole. Two kinds of treatment are in common use: the brush treatment and the tank treatment, the latter being preferable wherever possible and practical. This treatment deprives the fungi of food and also drives away wood destroying insects. The preservatives used for this purpose are creosote, carbolineum, zinc chloride, corrosive sublimate and copper sulphate. While tank treatment is expensive, in the end it is economical as the life of the pole is made much greater. Painting, while helping to preserve wood, will not prevent dry rot, which comes from the inside while wet rot comes from the outside. The decay at the butt of poles in contact with soil is greatly assisted by the moisture and comparative warmth of the soil and is much more noticeable near the surface of the soil. Coarse or well drained gravel will generally resist decay better than sandy or loam soil.

Factors Contributing to Pole Strength

The strength of poles usually varies with the cube of the diameter of the breaking section. If a pole having eight inches diameter has a breaking strength of, say, 1,500 pounds, then a similar pole ten inches in diameter will have a breaking strength of nearly twice that amount. Thus a comparatively small increase in diameter increases the strength very appreciably. The amount of taper varies greatly with different timbers and not only affects the strength of the pole, but largely determines the theoretical breaking point of the pole. Considering the effect of decay at the ground line, it will be seen that the amount of taper is very important. It takes nearly two hundred years for cedar to reach a size of 36" in circumference six feet from the ground line. The so called northern white cedars, while not of great strength, have a taper which is particularly suitable for poles.

Determining One's Choice of Poles

In the choice of poles one must consider not only the cost, but also their availability. While the cedar is preferable, many people find the chestnut equal to their requirements where the latter poles can be secured near the place where they are used. The wood is much harder and more difficult to climb; it is less durable and the taper is less economical than the cedar. It is, however, important to remember that the strength of the chestnut pole, all things being equal, is about 50 per cent greater than the cedar pole. Another characteristic of the chestnut is that it decays more rapidly below the

ground line, while the cedar decays more rapidly at the ground line. It also requires less time to reach maturity or about 55 years to reach a circumference of 36 inches. The cedar poles come from two varieties of trees: Northern white cedar, which grows in the northern states eastward from Manitoba, Canada, to Minnesota; and Western cedar or Idaho cedar, found in northern Idaho and western Washington. The latter is very popular on the Pacific coast and throughout the northwest. Its shape and size make it very desirable for the longer class of poles. It is rapid growing, requiring approximately 65 years to reach a circumference of 36 inches.

In some parts of California the redwood trees grow to great diameter and many of them were used by the Independent companies on toll lines. In view of the large diameter of the trees the poles have to be sawed before being put into use. Sawed poles were also used in some parts of Texas. In the South, yellow pine is the principal timber and this timber has to be creosoted before being put into use. If this is not done, the whole length of the untreated pole is liable to decay with great rapidity. Due to the very efficient methods of treating now in use, pine poles have become very popular with the Bell Telephone Co., and are known as "black diamonds."

In the building of toll lines a survey made a few years ago showed that out of all the poles in use at that time 63 per cent were cedar, 31 per cent chestnut and the balance juniper or pine. If a survey were made today, probably 65 per cent would be cedar and the balance treated pine. The comparative strengths of poles have been given as follows and are fair average values for the fiber stress in pounds per square inch: cedar, 3,600 pounds; chestnut, 5,000 pounds; yellow pine, 6,000 pounds. This is interesting and useful and demonstrates that size for size a chestnut pole is nearly 50 per cent stronger than a cedar pole, and yellow pine is stronger than chestnut; hence, the popularity of the treated yellow pine in recent years. However, in the choice of poles, consideration must also be given to the cost of transportation and distribution, as this affects the cost of building. In the treatment of yellow pine, it is said that the treating process adds about one-third more to the weight of the pole.

The A. T. & T. Co.'s Classification of Poles

For convenience in formulating specifications, the A. T. & T. Co. divides poles into seven classes, each designated by a letter. These specifications require that dimensions shall be according to the following tables:

CHESTNUT POLES—Minimum Dimensions of Poles in Inches.

Length of Poles in Feet	A Top	A 6 Feet from Butt	B Top	B 6 Feet from Butt	C Top	C 6 Feet from Butt	D Top	D 6 Feet from Butt	E Top	E 6 Feet from Butt
20	..	..	..	..	..	..	..	..	15½	23
22	..	..	..	..	..	..	..	..	15½	24
25	..	..	..	..	20	30	20	27	15½	26
30	24	40	22	36	20	33	20	31	15½	29
35	24	43	22	40	20	36	20	35	20	34
40	24	45	22	43	20	40	20	39	20	38
45	24	48	22	47	20	43	20	43	20	42
50	24	51	22	50	20	46	20	46	20	46
55	22	54	22	53	20	49	..	..	..	..
60	22	57	22	56	..	..	..	..	..	..

EASTERN WHITE CEDAR—Minimum Dimensions of Poles in Inches.

Length of Poles in Feet	A Top	A 6 Feet from Butt	B Top	B 6 Feet from Butt	C Top	C 6 Feet from Butt	D Top	E Top	F Top	G Top
20	..	..	..	..	..	..	..	..	15½	12½
22	..	..	..	..	..	..	..	15½	15½	12½
25	..	..	22	32	18¾	30	18¾	17½	15½	12½
30	24	40	22	36	18¾	33	18¾	18¾	18¾	..
35	24	43	22	38	18¾	36	18¾	18¾	18¾	..
40	24	47	22	43	18¾	40	18¾	18¾	18¾	..
45	24	50	22	47	18¾	43	22	22	18¾	..
50	24	53	22	50	18¾	46	22	22	18¾	..
55	24	56	22	53	18¾	49	22	22	18¾	..
60	24	59	22	56	..	..	..	..	..	..

WESTERN WHITE CEDAR POLES—Minimum Dimensions of Poles in Inches.

Length of Poles in Feet	A Top	A 6 Feet from Butt	B Top	B 6 Feet from Butt	C Top	C 6 Feet from Butt	D Top	D 6 Feet from Butt	E Top	F Top
20	28	30	25	28	22	26	18½	24	15	12
22	28	32	25	30	22	27	18½	25	15	12
25	28	34	25	31	22	28	18½	26	15	12
30	28	37	25	34	22	30	18½	28	15	12
35	28	40	25	36	22	32	18½	30	15	..
40	28	43	25	38	22	34	18½	32	..	..
45	28	45	25	40	22	36	18½	34	..	..
50	28	47	25	42	22	38	18½	36	..	..
55	28	49	25	44	22	40	18½	38	..	..
60	28	52	25	46	22	41	18½	39	..	..
65	28	54	25	48	22	43	....	..	..	..

Classes A, B and C poles are selected poles, being the stouter half of the "woods run." These poles are usually used for the heavier and more important lines and also at corners and railroad crossings. Below class C, the diameter at the base of the pole is not specified, the "woods run" being usually taken in these classes. The load factor applied horizontally at the center of the cross arm system is as follows: Class A, 3,100 pounds; Class B, 2,300 pounds; Class C, 1,500 pounds. The above is for new cedar poles.

Several methods are used for adding strength to a pole line lead; first, by using stouter poles; second, by placing them at shorter distances, or more poles to the mile; third, by guying and bracing. In exceptional cases, the so called A or H fixtures are used which consists of two poles with cross bracing.

Methods of Preserving Poles

According to statistics, the dead oil or coal tar, or coal tar creosote, has by far the best record as a preservative. The application of this treatment requires a rather elaborate plant, the principal feature of which is the treating cylinder, of which there may be several at each plant. This cylinder is sometimes 130 feet long and about 7 feet in diameter. It is constructed like a steam boiler shell, with both ends hinged so that it can be easily opened. Poles to be treated are piled in small cars and run directly into the cylinder at one end. The cylinder is then hermetically sealed and filled with steam. This steaming process lasts for several hours, the temperature and length of time being according to specifications. This steaming process softens and opens the wood cells and liquefies the sappy constituents of the pole. When this is concluded a vacuum pump is applied to the cylinder, which draws the liquids out of the timber to a large extent. When this flow of liquid from the condenser ceases, the pumping is stopped and the cylinder filled with the preservative from a large measuring tank. When the cylinder is completely filled with the preservative, pressure is applied to force the specified amount of oil into the poles, the treatment being known as the eight, ten and twelve pound treatment. When the oil pressure is released, the oil is pumped back into the measuring tank and the difference between the first and final readings on the gauge indicates the amount of oil absorbed by the pole. One modification of this method of treatment omits the initial steaming, and another applies a final vacuum to remove excess oil.

Concerning Butt Treatment of Poles

The most common method used for butt treatment is known as the brush method, the preservative being applied in a manner similar to paint either to the butt as a whole or only at the ground line as may be deemed expedient and necessary. The application of such treatment to green poles does not seem to give any real benefit, but it does extend the life of seasoned poles.

The open tank process has also been used in the treatment of the butts of poles. In this treatment the butts of the poles are placed in tanks and cov-

ered with the preservative to about one foot above the ground line. The preservative is then heated above the boiling point of water (212 F.) either by means of steam pipes within the tank or where these are not available by a fire built beneath it. This heating process converts the water in the wood cells into steam which evaporates by bubbling through the oil. The air in the wood cells is also expanded and expelled in a somewhat similar manner. Having been thoroughly heated in this manner, the preservative is either allowed to cool or the poles are transferred to another tank containing cold preservative. The object of this treatment is to form a partial vacuum in the wood cells, thus allowing the preservative to be forced into the poles by atmospheric pressure.

The life of the poles which have become rotted at the ground may be extended by some form of reinforcement. The most common method consists of setting a stub of new timber close along side the old pole and binding the pole and the stub together by means of twisted wire wrapping. When using a reinforcement stub in this manner it is well to treat the stub with preservative.

Also, There Are Reinforced Concrete Poles

The scarcity of wood and constant advance in the price of wood poles in some parts of the country has caused the development of reinforced concrete poles. The results thus far obtained show that these poles are remarkably uniform in strength and that their actual breaking loads are close to their computed values. They have been used to some extent especially on electric railway and high tension lines. While not very much in use for telephone purposes, they may become a necessity in the future, hence the following brief discussion is given:

The poles usually are square in section and are sometimes hollow. The usual taper is from 12 inches at the butt to 6 inches at the top. The walls of hollow poles are about two inches thick. The average weight of these poles are said to be about 2,000 pounds, of which 300 pounds is steel and 1,700 pounds concrete. Cedar and chestnut poles of equal height and strength would weigh about 500 and 1,000 pounds, respectively. The first concrete poles in America of which we have any record were made at the Isthmus of Panama about 1856. At first a wood core was used, but it was found that the wood had a tendency to swell and crack the concrete. The first reinforced concrete poles were made in France in 1896, and many of these are still in use. These poles were circular in section, solid and reinforced with small round rods and transverse wires. There is still much discussion as to whether the solid or hollow type pole is preferable.

Among the advantages of these poles are that they are virtually indestructible; require no paint or preservative; are impervious to fire, wind, sleet, rain, frost or the attack of insects; are sufficiently elastic to accommodate themselves to strains and shocks; and the reinforcing material protects the poles against lightning. It also is claimed that the first cost has now been reduced to approximately the cost of a wood pole of corresponding size.

In view of the fact that they have not yet become very popular in the telephone business and in any case would not appeal very strongly to the average small exchange owner or manager, it is not considered advisable at this time to give any further details regarding concrete poles. Those desiring further detailed information regarding these poles we would refer to the following manufacturers: Universal Portland Cement Co., 210 So. La Salle st., Chicago; Atlas Portland Cement Co., 134 So. LaSalle st., Chicago; National Reinforced Concrete Corp., San Francisco.

Proper Location and Setting of Poles

In so far as possible, the pole line should be located along county roads, public streets, lanes or alleys. Avoid private rights of way wherever possible to do so. Where the line is built on railroad rights of way, poles should not be set nearer the rail than twelve feet and at railroad crossings should conform to the requirements of the railroad over which it crosses. The average minimum clearance in this case is about 25 feet above the top of the rail, that is, the lowest wires should give this clearance.

All of the heaviest poles should be placed on the curves, corners and terminals. The length of the poles should be proportioned to the contour of the country so that the wires may be strung without abrupt changes in level. When the line passes through cities, all of the work should conform to the city requirements. When the line turns a corner, two poles should be used on a corner set as near to each other as possible and an additional pole should be set seventy-five feet from each corner. When the line curves from one side of the road to the other, the angle should be about 45 degrees and the span between the curve pole and the pole next to the curve pole, should be 75 feet long.

In locating poles, measure off the distance decided upon and place the stakes at equal distances (usually 130 feet) without regard to obstructions and place poles as near these stakes as possible. At curves and corners stakes should be placed according to predetermined specifications. No poles should be located in front of doors, drives or gateways. Stubs should be as heavy and stiff as possible and if it comes to a point where one must decide between putting a choice pole in as a stub or a cable or terminal pole, the choice should be for the stub, as "the stub might possibly be the key that holds the arch of your construction intact." Of all poles, the stub under strain is the most difficult, dangerous and expensive to move or replace. The most important item in pole construction, outside of guying, is keeping the pole lines straight.

Corner poles and guy stubs have a tendency to buckle; hence it is also necessary to so locate the poles and stubs that this tendency to buckle may be reduced to a minimum. So long as the pole or stub is straight, it will stand a heavy strain without buckling, whereas if it is crooked, the buckling process has already started and increases with every pound of strain applied. It is strange how easy even a stout pole can be started to buckling by wrong placement or a wrong application of guys. Frequently a guy stub or a corner pole is set perpendicular, then tamped and the blocks applied to give it the desired rake. This is wrong, for if the tamping has been well done, the result is apparent, namely, that the pole is buckled before the load was applied. The rake of the pole should be decided and pole set at that rake then tamped in position. This matter will be considered more fully later and is mentioned here to emphasize the necessity of proper selections of poles.

Use of Lightning Rods on Poles

It is usual to place lightning rods or wires on every eighth pole on a standard line of forty poles to the mile, and proportionately less in lines having fewer poles per mile. They should always be located in wet soil, as they are almost useless in dry or rocky ground. The wire used for this purpose is No. 9 or 10 B.B. galvanized iron wire. A small coil of the wire is left in the ground at the base of the pole and the wire is run up the side of the pole to the top and fastened with wire staples.

Tools Used in Building Pole Lines

It has been truly said that "tools make the workman." It this is true, then the secret of American industrial supremacy probably lies in the fact the the finest tools and implements are manufactured in this country. On arriving in this country the first thing a foreign workman notices is the splendid tools and equipment of our industrial centers. However, with every good thing, there seems to be also always a trashy one; hence, it is very

poor economy to buy cheap tools simply because they are cheap, as they prove expensive in the long run. Low price means low grade almost invariably, as quality and price are usually in strict proportion.

It is not our intention at this time to consider the full tool equipment necessary for any particular task, for the reason that the number of tools necessary varies with the task under way. Tools which are absolutely essential in the construction of a new plant are in most cases unnecessary and uncalled for in the maintenance and routine work of the telephone exchange.

The writer might give here a long list of tools covering practically every phase of telephone construction and maintenance work, but as these can be found in the tool manufacturers' catalogues and in construction books, it would seem wise to confine oneself at this time at least to tools necessary for light construction or maintenance work.

Shovels—There are several kinds of shovels, a few of which are useful and necessary in telephone work. The round point shovel and tiling spade are very popular for digging holes and trenches, and in moderately hard soil these alone are required. Where the ground is soft or sandy, or where the use of the pick is necessary, the round point shovel is best suited for the work. The square point shovel is only used in mixing concrete, and the square point spade for trimming up the sides and bottom of the trench. For hole digging in light construction work and average soil, the post hole digger fully meets all requirements. Many of the old-timers, however, even on light work insist on using the long handled shovel, the iron bar and the spoon, and it seems even at this late day that nothing takes their place. The shovels are usually made of solid crucible steel, extra heavy, the long handled shovels being provided with eight foot handles and twenty-two inch strap. The best spoon is the Western Union pattern. It is also eight feet long with a twenty-two inch strap.

Digging Bar—These are made from one and one-eighth inch octagonal steel, eight feet long, with a chisel point at one end and a sharp point at the other.

Pick—The common pick is made of iron with short steel points, and is frequently to be found on construction work. This is a serious mistake as the all-steel railroad pick is the only one that should be used. It can be sharpened over and over again until it is worn out. It is usually about two pounds heavier than the common pick and therefore much more efficient. The handles for picks are usually made of hickory and sold separately.

Hole Digger—The post hole digger is, perhaps, the most useful tool for maintenance and light construction work, although there are many telephone men who insist on the use of shovels in preference to the hole digger. The writer has found the Eureka pattern of post hole digger the most economical and practical.

Tamping Bar—The tamping bar is very essential, but nowadays very seldom seen on maintenance work, the average man being satisfied to use "any old piece of timber" or the end of the shovel handle. Tamping is a very important part of pole setting. For ramming the dirt or refilling trenches, the pear shaped dirt rammer is a very effective tool. It is six inches in diameter at the bottom and weighs about twenty pounds, the handle being about four feet long. Special rammers can be made up out of timber clamped together to suit conditions.

Framing Horses—These are made by spiking or bolting together two pieces of two by four hardwood, the bottom being strapped together by a cross arm brace or loop of wire. They are shaped in the form of an X.

Saws—These should have coarse teeth, not more than seven to the inch and be given a heavy set so as to insure a good clearance in soft timber. The average length is twenty-two inches, a very convenient size. On heavy construction work, a saw filing outfit with plenty of files should be conveniently located so that the saws can be regularly overhauled.

Draw Knife—The fourteen draw knife of the straight type is generally used. Curved knives are not considered practical or economical.

Squares and Chisels—The cheapest pattern of carpenter's squares have one leg twenty-four inches long and the other leg seventeen inches may be used. The only graduations necessary are in feet and inches to eighths. Framing chisels should be of the heaviest pattern and of first quality.

Pike Poles—These are used for raising poles and should be made locally; any carpenter will dress them by hand from clear pine or fir for little more than the ready made article will cost and they are much superior. The screw points including ferrules can be bought at the hardware store. Many nasty and serious accidents have been caused by defective pike poles; hence, the necessity of great care in selection. All knotty or cross-grained sticks should be rejected. They should be two and a half inches in diameter, dressed out and planed perfectly smooth and round with no taper at either end. They should be treated with several coats of boiled linseed oil. When the points are put on, the ferrule should be driven on first to avoid splitting the wood. The poles should be of several lengths and it is suggested that ten, twelve, fourteen and sixteen feet are the most useful.

Jenney—This is usually made of selected hardwood timber and is either rigid or made to fold as desired. In some cases it is made of heavy or tubular iron and the length in either case being from six to nine feet, the most popular being seven feet long.

"Dolly"—This is a little truck, having two wheels and is used for wheeling heavy poles into place.

In addition to the above there are many other tools used for guying, messenger, cable work, etc., and we may have to consider these in detail later.

A Suggested List of Tools

The following list of tools is suggested for the average telephone exchange for light construction work and maintenance purposes. The list shown is presumed to be sufficient for an exchange of less than five hundred telephones. In larger exchanges many of the tools will have to be doubled in quantity and the tools shown in the supplementary list added.

EXCHANGE MANAGER'S TOOL LIST

1 Long Handle Shovel—8 ft.
1 Long Handle Spoon—8 ft.
1 8′ Steel Digging Bar.
1 Short Handle Shovel—3′ round point.
1 Pick—Railroad.
1 Tamp—Oak with iron shoe.
1 Cant hook—medium size.
3 14′ Pike poles.
1 Hand Axe—No. 1—4″ blade.
1 2″ Framing Chisel.
1 Hand Saw—22″.
1 10″ Ratchet Braces.
1 $\frac{11}{16}$″x18″ Car Bit.
1 $\frac{11}{16}$″x12″ Car Bit.
1 $\frac{5}{8}$″x8″ Car Bit.
1. $\frac{7}{16}$″x18″ Syracuse Bit.
1 $\frac{1}{2}$″x18″ Syracuse Bit.
1 12″ Monkey Wrench.
1 Set 5″ D. S. Blocks.
100′ $\frac{5}{8}$″ Manilla Rope for Blocks.
100′ $\frac{5}{8}$″ Sisal Rope Hand Line (one hand line).
1 $\frac{3}{8}$″ Sash Cord hand line—50′.
30′ $\frac{3}{8}$″ Sash Cord for Buffalo grips.
2 Haven Clamps—large size.
1 pr. Buffalo Grips—No. 1 with pulley.
1 Pay-out reel—complete.
1 No. 31 Torch.
1 1 lb. Soldering iron (each iron weighing 1 lb.)
1 10″ Flat Mill Bastard File.
1 8′ Step Ladder.
1 Extension Ladder—18′—12′.
1 30″ Diamond Brick Drill.
1 Claw Hammer.
1 5-gal. Gasoline Can—wood encased.
1 Bench Vise—metal.
2 No. 31 Tool (socket wrench for No. 8 cans) (for cable plants only).
1 50′ tape line.
1 Cableman's Platform, 3′x5′ (for cable plants only).
1 Lantern with 1 red and 1 white globe.
1 10″ Bellows.
1 3-gal. Galv. Water Bucket.
1 Heavy Tree Trimmer.
1 Lineman's Canvas Tool Bag.
1 Test Set.
1 No. 30 Tool (socket wrench for No. 7A fuses) (for plants using W. E. frame).

SUPPLEMENTARY LIST OF TOOLS FOR LARGER EXCHANGES

Pike Poles—assorted—ten, twelve, fourteen and sixteen feet long.
Double sheave blocks, one set, eight inches, with $\frac{7}{8}$″ Manilla rope.
60′ $\frac{3}{8}$″ sash cord for Buffalo grips (30′ per pair).
Take-up Reel.
One Furnace.
One Nail Puller.
One fourteen inch Cooper's Knife.
One 2′ Steel Square.

They Helped Make Badger Meet a Success

Badgers at Madison

Lively Convention Draws Big Attendance—Practical Addresses Featured

Madison, Wis.—Wisconsin's fifteenth annual state telephone convention was the magnet for approximately 200 telephone men and women representing Independent and Bell plants throughout the state, and representatives of almost all of the leading telephone equipment and supply makers.

Among the interesting features of the program which will find reflection in the future activities of the association was the paper by Miss E. M. Westenhaver on the organization of women employees for the study of the public utility business. Miss Westenhaver outlined the methods of directing the training of women employees so they could function in correctly disseminating information relative to the utilities. She referred to the activities of the National Electric Light Association along these lines and advocated co-operative work among all utilities in employing this inviting educational opportunity. In citing evidence of the success of this work, she read a telephone company advertisement which appeared in Kansas City newspapers, headed, "She's a Neighbor Girl of Yours."

As a result of the address on First Aid made by F. R. Davis of New York, the convention endorsed the teaching of first aid in the public schools of the state, and intends to get activities behind the movement.

Co-ordination of radio and wire telephonic development was stated by W. B. Schulte to promise a decided and probably generally unsuspected advance in communication practice. He related that authorities forecast a $500,000,000 business in radio in 1925 and suggested that telephone companies carefully look into the profitable possibilities of the sale of radio supplies. In this connection he counseled handling standard equipment and getting a quick turn-over due to the rapid scientific development in radio. He also advised contact with members of the Radio League. Mr. Schulte said that as a result of radio, long distance telephone and telegraph bills in Chicago alone showed an increase of $100,000 last year.

Harry Eldridge, Division Commercial Supt. of the Illinois Bell, and W. S. Vivian, director of Public Relations for the Middle West Utilities Co., spoke on public relations problems, and brought to the Badger State folks the good-will educational suggestions that they have ably presented before other groups of telephone company executives. Mr. Eldridge's paper concerned the public relations and morale problems of the smaller exchanges.

An outline of the work accomplished by the Electrical Fellowship of the Wisconsin Utilities' Association concerning inductive interference was presented in the address John N. Cady, secretary of the Utilities' association made on "Experiments with Wave Filters."

A survey of the activities of the national association with special mention of the focused effect of the national body's work upon Wisconsin telephone companies was given before the meeting by President F. B. MacKinnon of the United States Independent Telephone Association. An outline of the work of the Wisconsin Utilities' Speakers Bureau was presented by Frantz Herwig, director of that bureau. Other brief talks on subjects related to the Wisconsin telephone industry were

made by men prominent in the association's councils. Considerable attention was given to the subject of storm insurance, with special attention being given to one insurance company's proposal for a storm rate, dependent upon placing other risks of the state's telephone companies with the insurance concern. The importance of safeguarding business records was stressed in a paper read by E. C. Smith, Record Protection Chancellor.

A banquet was given by the supply men to the convention attendants, during which the tribute paid by Lewis E. Gettle, chairman of the Railroad Commission of Wisconsin to the telephone industry, was broadcast. Melody from the Ray O Lite chorus and dancing made the affair sprightly.

An excellent showing of equipment was staged by the representatives of companies selling equipment, supplies and services to the industry.

Contemporaneously with the executive sessions, an operators' conference was held.

W. L. Bott Purchases Remington (Ind.) Exchange

Rensselaer, Ind.—William L. Bott, owner of Jasper County Telephone Co. and the Wheatfield Telephone Exchange, has acquired the Remington Telephone Co. His son, Neil N. Bott, will move to Remington to take over the management of the plant. The Rensselaer Exchange has 1,300 subscribers, Wheatfield approximately 100 and Remington about 500, making in all about 2,000 telephones under the control of Mr. Bott.

Fort Meyers, Fla.—Lee County Telephone Co. is to erect a new exchange building here.

WANTED—To purchase two copies each of TELEPHONE ENGINEER for July and September, 1921. Address: "T. H. I.," care TELEPHONE ENGINEER, 28 E. Jackson Blvd., Chicago.

Machine Switching Costs New York Fifteen Million

New York, N. Y.—Need for introduction of machine switching telephone service in New York City was emphasized by H. C. Carpenter, General Manager of the New York Telephone Co., recently at the continuation of the hearing before the Public Service Commission on the company's application for immediate temporary increase in telephone rates.

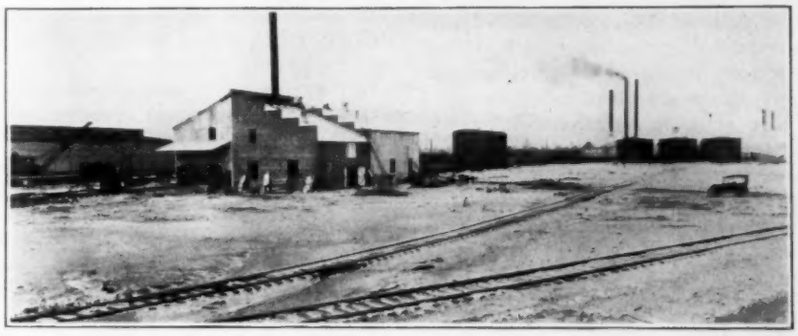
Mr. Carpenter testified that machine switching was introduced in New York City because forecasts showed that it was absolutely necessary if service is to be kept at its present levels of efficiency for years to come. In the next 10 or 15 years, he testified, the number of telephones in New York City will be double that of today, with double the number of central offices and a corresponding increase in complexity and difficulty of operation if the manual system were continued.

Mr. Carpenter also testified that approximately $15,000,000 had been expended by the company installing machine switching and that during 1924 and 1925 the company expected to install 206,000 machine switching lines which would make available 412,000 stations.

Suspension from use of the service for two days is the penalty imposed by the French Ministry of Posts and Telegraphs upon subscribers who become angry with the operators.

Open New Creosoting Plant

Texas Interests Begin Operating at Orange



General View of Texas Creosoting Plant at Orange, Tex.

Orange, Tex.—The Texas Creosoting Co. has completed its new plant and ran the first charge through on April 1st.

This plant is claimed by its owners to be probably the most modern creosoting plant in existence. It was designed by Grant B. Shipley, of Pittsburgh, Pa., and the construction has been carried on under the direct supervision of R. S. Manley, president of the company, and C. M. Tilley, superintendent. Actual construction began with the deposit of from three to five feet of Sabine River sand over the entire twenty-three-acre site by an hydraulic dredge. This sand provides an ideal seasoning yard for piles, poles and timber, and by obstructing the growth of grass, weeds, etc., helps to eliminate the fire risks.

The first shipment of equipment was received on the job on October 24th, since which date a large force of men has been engaged in track laying, pipe line construction and the erection of buildings and placing of the two great treating cylinders, the boilers, pumps and compressors and tanks. Five months is considered a record for the erection of such a plant.

The plant is primarily a high-pressure Reuping plant. Two treating cylinders, each 8' by 124', with superimposed Reuping and pressure cylinders, are tested to 375 pounds pressure, for a working pressure of 250 pounds. Instead of being located at one end of the plant site, the treating cylinders, compressors, etc., are in the center, making it possible to establish a "flow" of material from the storage or receiving end, through the treating plant and thence to the shipping or storage yard. Storage for 25,000 poles and 250,000 railroad ties is provided, and a full stock of each is expected to be carried at all times.

Compressed air is used throughout for applying air and oil pressures in the treating cylinders and all compressors, pumps and the planing mill is operated by individual electric motors, greatly lowering the fire risk and lessening the likelihood of a general breakdown. The locomotive and three locomotive cranes, as well as the boilers, use fuel oil.

A wharf 50' by 350' is being built. This will carry two tracks and storage space for 75,000 ties and will make possible the loading and unloading of vessels with the locomotive cranes from or to the cars. With a thirty-foot channel to the Gulf, it will be possible to dock and unload European steamers at the company's own wharf, whence English creosote oil may be pumped direct into the million-gallon storage tanks.

The capacity of the plant is three and one-half million feet, board measure, per month. It is located near to the source of supply of southern yellow pine, and has excellent shipping facilities by deep water and rail.

Photographic Transmission Over Wires Is Accomplished

Late in May announcement was made that photographs had successfully been transmitted over the wires of the American Telephone and Telegraph Co. from Cleveland, O., to New York City. This was in the nature of a practical demonstration over a line more than 500 miles long, and it is stated that the system has been perfected to a point where it can be placed in use wherever there is a demand for it. The transmission of pictures is of particular interest to newspapers, and officials of the telephone company have said that there is no reason why newspapers may not have picture sending and recording devices in their offices with leased wire circuits for transmission just as they now have leased wires for telegraphic news transmission and reception.

The scientific principles underlying the operation of the system are not new, but only in recent years has apparatus been available to make the operation practicable. In the transmitting apparatus a beam of light is allowed to shine through the photograph film onto a photo-electric cell. The film is placed on a slowly revolving cylinder and the beam of light moves across the film, much as the needle of a phonograph moves along the surface of a cylindrical record. The intensity of the light striking the photo-electric cell varies in a manner depending upon the variation of light and shade in the film. A direct current is controlled by the photo-electric cell and is passed through vacuum tube apparatus for modulation and amplification before it passes through the line. In this way the variation in light on the cell is translated into variations in current strength in the line.

At the receiving mechanism the varying current is used to produce variations in a beam of light which plays upon another revolving cylinder carrying a photographic film. With each revolution of the cylinder the beam is advanced by a screw mechanism. In this way the film is covered by parallel lines a small fraction of an inch wide. The width of the beam of light is controlled by the current so that the values of light and shade on the finished photograph are determined by the width of the black lines produced when the beam is varied.

One of the special problems is the control of the speed of the revolving cylinders so that the sending and receiving cylinders move in exact synchronism. This is provided by a special synchronizing device, called the light valve, which has been developed in the Western Electric Laboratories at New York.

The apparatus used in the Cleveland-New York tests transmitted a 5"x7" picture, and the time required was 4 minutes and 36 seconds. A picture was reproduced in New York in 44 minutes after it was taken in Cleveland. Among the advantages claimed for the system is that it will transmit any positive transparent film, such as can be supplied by any photographer, and also will transmit handwriting, printing and line drawings. Films can be used while wet, thus saving the time required to dry them.

Division of Business Eliminates Duplication in Southern Illinois

The Commercial Telephone & Telegraph Co., of Olney, Ill., has been buying a number of telephone plants, and selling other plants recently. These purchases and sales have eliminated the ragged ends of the company's toll territory and it now has seven full and two half counties without a Bell toll line or a Bell telephone within the territory. The Commercial company gained a few more stations by its purchases than it had before it made the sales. These purchases and sales, the management states, are beneficial to both the Bell and Commercial company, on account of the paralleling toll lines throughout the entire territory that were owned by the two companies. The Commercial company always has developed its toll lines to the highest standard, using practically all copper circuits, and maintaining the lines well.

Our Literary Digest

Review of Recent Publications on Telephony and Allied Subjects

"Telephone Circuit Diagrams," by John M. Heath, McGraw-Hill Book Company, New York.

As the author says in his preface, this is not a treatise on telephony but is rather a handbook of circuit diagrams. Bound in the specification handbook size, it is arranged for pocket of the worker rather than the shelf of the office. In makeup, it consists of 72 plates of circuit diagrams with some 200 pages of explanatory material. The material is divided into parts and sections for convenience in reference.

Part One is devoted to local battery systems. The first section deals with the local battery telephone instrument. The fundamental principles of the circuits are shown and the operation is described. The second section is devoted to the local battery switchboard, starting with the symbols for individual parts and ending with complete circuits through the switchboard from subscriber to subscriber. In section three, eight plates are shown to illustrate various types of local battery party lines, including code ringing, selective ringing two-party lines and both polarity and harmonic ringing 4-party lines.

Part Two is the common battery division of the book. It is likewise arranged in three sections, Section 4 dealing with common battery telephones; Section 5 with common battery switchboards and Section 6 with common battery party lines. In Section 5, circuits developed by the Western Electric Company, the Kellogg Switchboard and Supply Company, the Stromberg-Carlson Telephone Mfg. Co., and the Dean Electric Co. are shown. The author justifies the inclusion of Dean circuits in his introduction by saying that, although they are no longer made, they represent sound practice and represent principles developed by W. W. Dean rather than apparatus manufactured by the company that bore his name. The circuit drawings are well arranged and are unusually clear. The explanations accompanying them, although necessarily brief are logically and concisely arranged. The book, while covering much of the same material that can be found in other places, on account of its convenient arrangement, should prove to be extremely useful to telephone men.

J. D. Ellsworth Is Made Bell Assistant Vice-President

New York, N. Y.—J. D. Ellsworth, publicity manager of the A. T. and T. Co., has been made an assistant vice-president of the company in charge of publicity. Mr. Ellsworth, a native of Iowa, came into the telephone industry from the newspaper field. He has been connected with the Bell's publicity work for many years.

Davis J. Cable, Ohio Pioneer, Dies at Lima

Lima, Ohio.—Davis J. Cable, one of the organizers of the Lima T. and T. Co. and president of that company since its organization in 1895, died May 19, at Lima. Mr. Cable also was one of the organizers of the Ohio Independent Telephone Assn., and was active in its work. For a number of years he was president of the Delphos (O.) Home Telephone Co.

New Nebraska Field Secretary Is Appointed

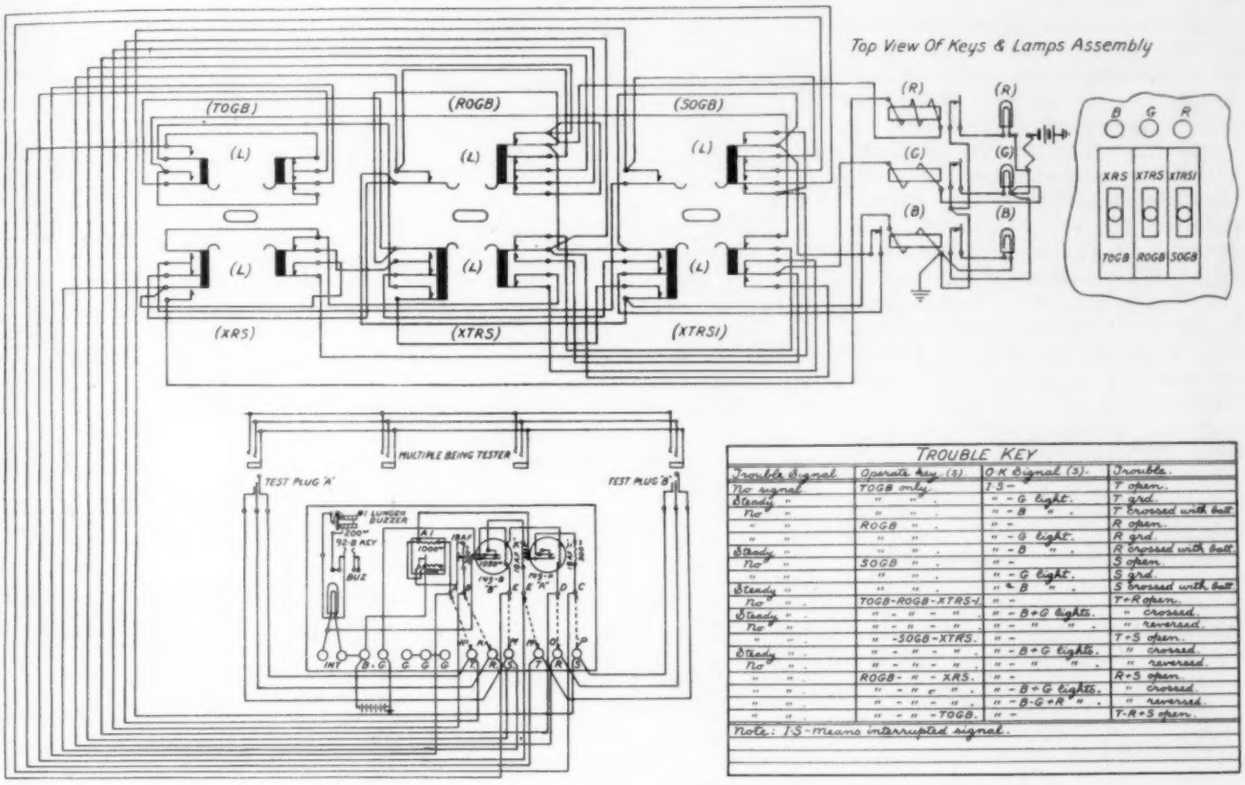
The Nebraska Telephone Association has appointed G. H. Presson, Field Secretary. State associations are requested to put Mr. Presson on their mailing lists to receive all notices, circulars, pamphlets, etc. His address is Telephone Building, Lincoln, Neb.

Dallas, Tex.—Southwestern Bell Telephone Co. is spending $4,000,000 for 1924 construction in Texas.

Multiple Trouble Test Set

A Convenient Test Set for Quick and Accurate Indication of Trouble in Dead Switchboard Multiple Is Described—Also, a Detailed Description of Its Operation Is Given

By R. Senay



TROUBLE KEY

Trouble Signal	Operate key (s)	O K Signal (s).	Trouble.
No signal	TOGB only	I.S-	T open.
Steady "	" " "	" - G light.	T grd.
No "	" " "	" - B " .	T crossed with bat.
" "	ROGB " "	" -	R open.
" "	" " "	" - G light.	R grd.
Steady "	" " "	" - B " .	R crossed with bat.
No "	SOGB " "	" -	S open.
" "	" " "	" - G light.	S grd.
Steady "	" " "	" - B " .	S crossed with bat.
No "	TOGB-ROGB-XTRS-I	" -	T-R open.
Steady "	" - " - "	" - B+G lights.	" crossed.
No "	" - " - "	" - " " .	" reversed.
" "	" -SOGB-XTRS.	" -	T-S open.
Steady "	" - " - "	" - B+G lights.	" crossed.
No "	" - " - "	" - " " .	" reversed.
" "	ROGB- " - XRS.	" -	R-S open.
" "	" - " - " .	" - B+G lights.	" crossed.
" "	" - " - " .	" - B-G+R " .	" reversed.
" "	" - " -TOGB.	" -	T-R-S open.

Note: I.S-means interrupted signal.

Fig. 1. Complete Circuit of Multiple Test Set

When additional multiple is placed in an existing switchboard or a new multiple switchboard is installed, a complete test of the multiple must be made before the switchboard is cut into service. This test is usually made by testing the multiple lines, one by one and noting those that show trouble. The trouble is then located and cleared before the lines are used.

In order to do this work efficiently, a special multiple test set was designed by the author. This set has the advantages that it gives an exact indication of the nature of the trouble, it is simple in operation, the tests can be made rapidly and an inexperienced tester can determine the nature of trouble existing. To give some idea of its simplicity, it may be said that seven operations will indicate the nature of nineteen different types of trouble.

The test set consists of a group of three double-throw keys with indicator lamps and buzzer and relays for controlling the circuits. The complete circuit is shown in Fig. 1.

Two switchboard cords and plugs are used to connect to jacks at the ends of the multiple being tested. If the multiple is clear, an interrupted o. k. signal will be given by the buzzer. If trouble exists, the buzzer signal will not be operated or will operate steadily. The keys are then operated in the sequence shown on the chart. When the interrupted signal is again heard the trouble is indicated by the lamps. Thus key ROGB is used for testing the ring wire. If no signal is heard when the plugs are inserted and the interrupted o. k. signal is heard when key ROGB is pressed, if no lamp is shown the ring is open. If lamp G glows, the ring is grounded, or if lamp B glows, the ring is crossed with battery. Other combinations are shown on the chart and the tester soon becomes acquainted with the indications so that the nature of the trouble is quickly found.

In order that the operation of the various circuits may be understood more thoroughly, the following detailed description of the circuits and indications is given:

1. NO TROUBLE—When the multiple is free from troubles, an interrupted or o. k. signal will be noted. All the keys are normal, and the following circuits are closed: (T-F), (R-D), (S-C), (TI-A), (RI-B), (SI-E).

2. TIP OPEN—In the case of an open tip no signal will be noted. Operate TOGB key ONLY (see trouble key). Circuit (TI-A) is open. Circuit (T-F) is open. Circuit (A-F) is closed. TI is connected to G relay battery. T is connected to B relay ground. An interrupted o. k. signal is noted, thus indicating an open tip.

3. GROUNDED TIP—A steady signal will be noted whenever the tip is grounded. Operating TOGB key ONLY will shunt out the B relay, but will operate the G relay. The G lamp will light and an o. k. signal will be noted, thus indicating a ground on the tip.

4. TIP CROSSED WITH BATTERY—No signal will be noted. The operation of TOGB key only will op-

erate the B relay. Open the operating circuit of the G relay (thus preventing its operation by difference of potential battery) and light the B lamp.

5. RING OPEN—No signal will be noted. The operation of ROGB key only will open circuit (RI-B), (R-D), and will close circuit (B-D). Ring will be connected to B relay ground and RI will be connected to G relay battery. An o. k. signal will be noted.

6. RING GROUND—No signal will be noted. Operate ROGB only. B relay will be shunted out. G relay will operate and G lamp will light, thus indicating a ground on the ring.

7. RING CROSSED WITH BATTERY—A steady signal will be noted. Operation of ROGB key only will operate the B relay, open the operating circuit of the G relay and light the B lamp. The o. k. signal is also noted.

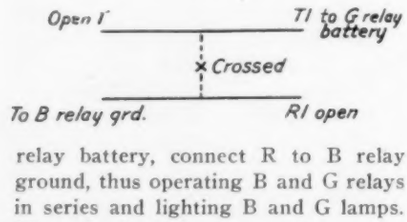
8. SLEEVE OPEN—No signal will be noted. Operation of SOGB key only will open circuit (SI-E), open circuit (S-C), close circuit (E-C), connect SI to G relay battery and connect S to B relay ground. An o. k. signal also will be noted.

9. A GROUNDED SLEEVE — No signal noted. Operation of SOGB key only will shunt out B relay, operate G relay, light G lamp and give o. k. signal.

10. SLEEVE CROSSED WITH BATTERY—A steady signal is noted. Operation of SOGB key only will open operating circuit of G relay, operate B relay, light B lamp and give o. k. signal.

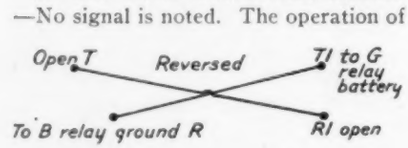
11. A TIP AND RING OPEN—No signal is noted. The operation of TOGB, ROGB and XTRSI keys will cause an o. k. signal.

12. TIP AND RING CROSSED—A steady signal is noted. The operation of TOGB-ROGB and XTRSI keys will open circuit (T-F), open circuit (TI-A), close circuit (A-F), open circuit (RI-B), open circuit (R-D), close circuit (D-B), connect TI to G



relay battery, connect R to B relay ground, thus operating B and G relays in series and lighting B and G lamps. The o. k. signal is also noted.

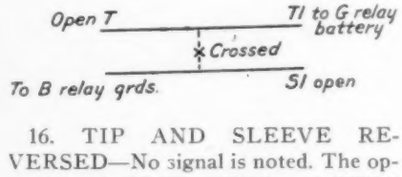
13. TIP AND RING REVERSED—No signal is noted. The operation of



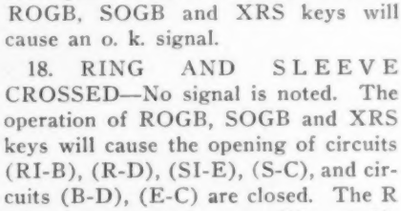
TOGB, ROGB and XTRSI keys will operate B and G relays in series, light B and G lamps and give the o. k. signal.

14. TIP AND SLEEVE OPEN—No signal is noted. The operation of TOGB, SOGB and XTRS keys will cause an interrupted signal.

15. TIP AND SLEEVE CROSSED—A steady signal is noted. The operation of TOGB, SOGB and XTRS keys will open circuit (TI-A), open circuit (T-F), open circuit (SI-E), open circuit (S-C), close circuit (A-F), close circuit (E-C), connect TI to G relay battery, connect S to B relay ground, operate B and G relays in series, light B and G lamps and give the o. k. interrupted signal.

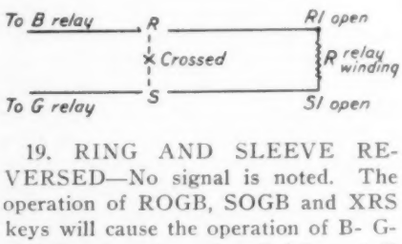


16. TIP AND SLEEVE REVERSED—No signal is noted. The operation of TOGB, SOGB and XTRS keys will cause the operation of B and G relays in series, lighting the B and G lamps and giving the o. k. signal.

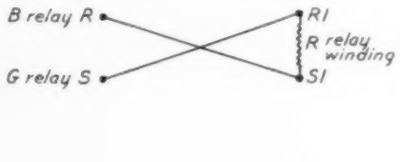


17. RING AND SLEEVE OPEN—No signal is noted. The operation of ROGB, SOGB and XRS keys will cause an o. k. signal.

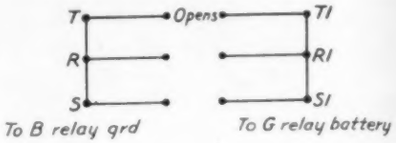
18. RING AND SLEEVE CROSSED—No signal is noted. The operation of ROGB, SOGB and XRS keys will cause the opening of circuits (RI-B), (R-D), (SI-E), (S-C), and circuits (B-D), (E-C) are closed. The R relay is connected across RI and SI, but is shunted out by the cross. The G relay battery is connected to S. The B relay ground is connected to R. Thus, B and G relays operate in series, B and G lamps light and an o. k. signal is noted.



19. RING AND SLEEVE REVERSED—No signal is noted. The operation of ROGB, SOGB and XRS keys will cause the operation of B- G- and R relays in series, B- G- and R lamps will light and the o. k. signal will be noted.



20. TIP, RING AND SLEEVE OPEN—No signal is noted. The operation of TOGB, ROGS and SOGB keys will give an o. k. signal.



Dixon (Ill.) Installation Is Inspiration for Italians

Dixon, Ill.—According to F. C. King, European representative for Stromberg-Carlson, at Bari, Italy, a telephone switchboard was installed last year which is an exact duplicate of one over which the Dixonites daily send their calls.

One of the Dixon Home Telephone Co.'s souvenir booklets describing the Dixon central office equipment, together with copies of local traffic records, induced the Italian company to order a duplicate of the local board excepting that it was equipped with a smaller number of wires. It is said to be the only common battery switchboard in Europe using standard American equipment and regular wall and desk type telephones and the only one using the harmonic party line system such as is used in Dixon.

The system in Bari is operated by the Societa della Puglie and while the city has a population of 135,000 they had only 440 phones in use April of 1923; at present they have 960 and have ordered a 920-line addition for their exchange, indicating that they like the American type of service.

Approving Editorial on "Radio Antenna Hazard"

"TELEPHONE ENGINEER,
"CHICAGO.

"Just a line to tell you that I appreciate very much the May issue of the ENGINEER. It is full of interesting articles, the ones by Mr. Kirk and Mr. Higgins being of special interest, for to me the construction and maintenance of the telephone plant are the most interesting parts of the work.

"Regarding your editorial concerning 'Radio Antenna Hazard,' it is very timely.

"Our company has always refused any one the right to the use of our poles; also has tried to prevent crossing leads.—C. W. Kugelman.

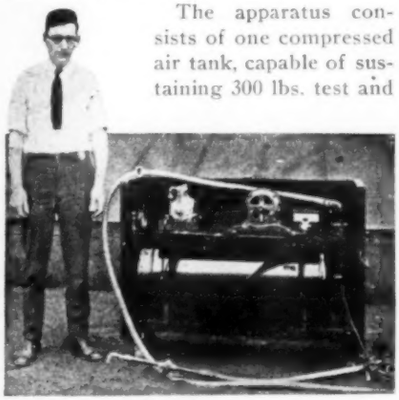
Slayton, Tex.—Slayton Chamber of Commerce, which has completed recently 25 miles of rural telephone line in the Slayton trading area, is contemplating further extensions.

LINE AND DESK

FISHING INTERIOR CONDUITS WITH COMPRESSED AIR

An ingenious substitute for the present method of "fishing" interior conduits by hand with a wire has been found by John T. Myers, a Buffalo wireman, who has invented a machine to do the work by compressed air.

The necessity for something different in the line of fishing interior conduits came up about the time the installation department started work of installing the telephone system in the new Hotel Statler, at Buffalo. The old method of fishing conduits with the flat steel fish tape was considered too slow for such a big job.



Compressed Air Conduit Fishing Apparatus

The apparatus consists of one compressed air tank, capable of sustaining 300 lbs. test and 150 lbs. working pressure, and 1¼ H. P.—110 volt motor heavy duty, belted to a 4-cylinder air pump mounted on four wheels and enclosed with sheet iron, with top cover hinged. A check valve was installed between the pump and air tank to maintain tank pressure. A gauge was installed on the tank for recording the air pressure in pounds. About 75 lbs. pressure was used for blowing and fishing the conduits. A relief or safety valve was installed on the tank for "Safety First," so as to prevent any over-compression in the tank, together with the necessary hose connections for carrying the compressed air to the conduits. This hose was approximately 25 feet long. The method of "fishing" the conduit was as follows:

First the conduits were blown out. In all cases every conduit was blown clear and clean. Second, after conduits were blown out they were then "fished," with the fish line left in as a pull-in-line. These lines were re-used. The line was fed through a small hole in the back of a 90-degree nipple, same size as conduit, slightly tapered at the end, allowing the line to run through and out the nozzle end. Any suitable waste material or "mouse" was fastened on the fish line and inserted in the conduit. By means of a lever valve located back of the nozzle, air was released which forced the "mouse" on the fish line through the conduit. This method proved so successful that two men could "clean" and "fish" an entire floor consisting of seventy-nine rooms in two days. They were also saved a long, laborious job, time and money. The approximate cost of this blower equipment was less than $50 for material—most of it second-hand, plus one man's time for one week. This blower can be used for cleaning out motors and generator armatures, field coils, etc.

What the future of this new method will be and how universal its application will become is not at present known. In any case, inventor Myers is to be congratulated for his ingenuity. —"Telephone Review."

AN OBJECTION TO SECTIONALIZING CABLE FOR TESTING

In answer to a suggestion for sectionalizing the cable sheath and messenger proposed by F. B. Woods of Ottawa, Ontario, in the May issue, another Canadian subscriber who wishes his name omitted has the following suggestion to make:

"Regarding your request for comments on cable device, shown on page 38, May issue of TELEPHONE ENGINEER, there is no detail given concerning the composition of the splice, which I presume is a special insulated sleeve, insulating the different cable lengths from each other.

"This scheme seems workable in a magneto exchange, but in a common battery exchange your wet spot would probably ground through its own pairs to the ground terminal of the exchange battery.

"It's true the lines could be picked out at the main frame, but this oftentimes would not be necessary, especially in the case of dampness, where service can still be given.

"It is questionable whether the added cost of construction would be worth the gain of being able to insulate each section of the cable and you would be taking a chance as to whether the insulated sleeve would stand up against the straight sleeve.

"You would also have to have an underground box or an insulated sleeve between the underground and the aerial, but while it must be admitted these leaks are hard troubles to find they can be handled by taking a bridge measurement and a check measurement, giving the location to the cableman and let him take the cable set and go to it."

Our correspondent has indicated the principal difficulties of the proposed method and we are inclined to agree with him that the gain would not be worth the added cost. There is still room for the development of more convenient and reliable methods of locating light grounds caused by dampness, but the blowing of sleeves for testing purposes may be reduced to a minimum by intelligent use of the testing means now available.

"In spite of all, a few people have managed to attach to our poles without our knowledge or consent.

"About May 1 a notice was issued through the newspapers that all aerials would have to be removed from our poles by May 15 or they would be removed by our employes.

"This week we intend to remove those remaining. These are very few, as most people did as we requested.

"One trouble with the aerial is, many people either discontinue the use of their sets or sell them and leave the dead aerials up.

"To date no accidents have occurred in our vicinity and we intend that none shall if we can prevent them.

"Thanking you again for your very interesting May issue."—C. W. Kugelman, Portsmouth, Ohio.

A CASE OF FALSE RINGING

We are operating a magneto exchange with metallic party lines, using grounded ringers. Occasionally, when a bond breaks on the rails of the traction line, we have complaints of false

ringing. Usually, we find the bad bond, have the railway company fix it and the trouble disappears. In one case, however, this did not clear the false ringing and the trouble had me puzzled for quite a while. Then, I found that one side of the drop coil at the switchboard was grounded on the frame. After the coil was changed, the trouble disappeared and did not return.—Contributed by C. R. Abdon.

WILL A SHOVEL STAND ON ITS HANDLE?

The other day at noon, we heard Bill, the foreman, say to one of the new men: "Harry, take that long handled shovel and make it stand up on the end of the handle."

"Give me credit for a little brains," replied Harry, "even if I don't know what a left-handed transposition pin is."

"Well," said Bill, "I saw you on top of a ladder, this morning, and you were trying to reach a knob that was five feet away. It was lucky that the ladder and you didn't act like the shovel would if you tried to stand it on its handle."

IRON SLEEVE EXPERIENCE

In the May number of this department, an appeal was published for experiences of telephone companies in the use of iron sleeves. As usual, we have had a prompt and helpful response from our readers and much good information is made available to our querist. The first reply came from O. C. Rutledge, wire chief of the Mount Sterling Telephone Co., Mt. Sterling, Ill. Mr. Rutledge's letter follows:

I have been handling iron wire over a period of over twenty-five years and think, perhaps, my experience may be of interest. When iron sleeves first came out, I tried them but found them to be stiff and hard to work, and they rusted badly both inside and out when in the line. So I gave up the use of them as unsatisfactory.

Something like ten years ago, a tinned copper sleeve was put on the market and I tried them out and found them to be entirely satisfactory, either for new or old work. I have used thousands of them and never yet had a failure, mechanically. So far as I can determine, they make a good electrical joint. In fact, I am convinced that they are the only thing to use on badly rusted iron wire. I have opened some of them after years of service and found them to be just as good inside as the day they were twisted up. Next to a soldered joint, they are the best, and I find few men who can be trusted to make a good soldered joint—even on new wire. I give them three and a half turns, which makes the line apparently pass straight through the sleeve, and I usually bind the wire back, cut off about one half inch past the sleeve, and press it down into groove of sleeve. This is not necessary but it makes a secure and neat-looking splice.

Mr. N. E. Branson, superintendent of the DeKalb County Telephone Co. of Maysville, Mo., gives his experience as follows:

"In your May issue of Telephone Engineer, an inquiry appeared on page 36, headed: 'Who Has Used Iron Sleeves.' From the writer's viewpoint, this has been a very much neglected, yet a very important factor in the construction of iron circuits. I will speak only from my own personal experience in regard to the use of iron sleeves within the past twelve years, and what is said may be considered upon its merits: I have found no better way in making an iron wire splice, (outside of soldering it) than with the use of a sleeve, in connection with the standard grades of iron wire which are now upon the market, for telephone line construction. With the sleeve splice properly made up, with not less than two and one half complete turns, the wire joints have been found to remain in good condition.

"Several iron circuits which I made up with sleeves some twelve years ago, are testing with the same continuity, and efficiency as to conductivity as when first installed, as is shown by the Wheatstone bridge tests."

Our good friend, W. R. Brown, Engineer of the Lafayette Telephone Co., Lafayette, Ind., informs us that his company has been using tinned copper sleeves for more than a dozen years. The only trouble experienced has been a few high resistance joints where the workman did not clean the wire properly. These occur also in Western Union joints under similar conditions, so this fact is not really to be counted against the sleeve joint.

With this uniformly favorable report, it would seem that the tinned copper sleeve offers a very satisfactory method of connecting iron line wire. No doubt, many companies have been deterred from using them because of the slight additional cost over an unsoldered joint. If cost is to be considered, it is a question as to which actually cost more: a sleeve joint or a well soldered joint of the ordinary type. If any other of our readers have comments to make on this subject, we will be glad to give them space.

A GOOD METHOD OF MAKING GROUND CONNECTIONS

A very important matter which has come to the writer's attention from time to time, and which seems to have been very much neglected by a great many telephone men, is proper groundings. A great majority of the smaller telephone companies operating today, use the single wire, or ground return circuits. In this case, the ground rod or wire must bear one side of the circuit and, therefore, is entitled to the same consideration as to its conductivity efficiency as the line wire of that circuit. Iron wire, or iron rods, driven into the earth as a grounding soon rust, thus introducing enormous resistances and cutting down the transmission efficiency to a great extent.

The most inexpensive, yet the most efficient grounding for this type of circuits as found by the writer through extensive tests in various soils, is a No. 8, or No. 10 copper wire. This wire can be placed wherever a rod can be driven by using the rod only for making a hole for the wire and removing the rod for the next job. A little further economy may be used by making only that part of the wire which enters the earth copper, and the remaining or upper part of a No. 12 or No. 14 iron wire.* Try this out: take a Wheatstone bridge measurement of your circuits before and after the change; make frequent tests, say every month (providing the wire side of the circuit is right), and note the changes which take place. **"Experience is a good teacher."**—Contributed by N. E. Branson.

(*Editor's Note—But be sure and solder the connection between the iron and the copper wire.)

WATCH THE STRAY CURRENTS

In recent months, several cases have come to our attention where telephone companies, after years of apparent freedom from trouble, suddenly have found themselves facing severe losses, due to deterioration of underground cable caused by electrolysis. Slowly but surely, the stray return currents from street and interurban railway systems have been eating away the cable sheaths and finally the day has come when the sheath is gone. Water enters the core of the cable and a new piece of cable must be placed and the old cable junked. The action of the current may be very slow and years may pass before trouble even is suspected.

This is a matter in which no chances can be taken by a telephone company having underground plant in cities or towns with electric railways. A properly designed and installed mitigation system, properly maintained, will prevent loss. The cost of an electrolysis survey and system for relief of such difficulty is so small, compared to the cost of the cable plant protected, that it is strange that every company has not taken this precaution to prevent possible loss in its plant.

A NUMERICAL INDEX TO THE TELEPHONE DIRECTORY

The subject of providing a numerical index for the telephone directory so that the name of the suscriber may be found if the telephone number is known; frequency has been discussed among telephone men. Occasionally, there is use for such a list but most telephone companies have felt that the

The Road to Home

Though written faithfully, his letters from home seemed to have had a way of arriving at his hotel in one city just after he had left for the next —and of never catching up.

Three weeks passed—business conferences, long night journeyings on sleepers, more conferences—with all too little news from home.

Then he turned eastward. In his hotel room in Chicago he still seemed a long way from that fireside in a New York suburb. He reached for the telephone—asked for his home number.

The bell tinkled cheerfully. His wife's voice greeted him. Its tone and inflection told him all was right with the world. She hardly needed to say, "Yes, they are well—dancing right here by the telephone. . . . Father and mother came yesterday. . . . Oh, we'll be glad to see you!"

* * * *

Across the breadth of a continent the telephone is ready to carry your greetings with all the conviction of the human voice. Used for social or business purposes, "long distance" does more than communicate. It projects you—thought, mood, personality—to the person to whom you talk.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

use did not justify the expense of publishing it. There also have been other objections to the use of such an index. Frequently, outside agencies have prepared such lists from the telephone directory and have circulated them for advertising purposes.

There are many reasons why such an unauthorized list may cause operating difficulties for which the company is blamed. Recently President C. A. Rolfe of the Southwestern Home Telephone Co., Redlands, Cal., learned that such a list was to be published. In order to forestall its publication, Mr. Rolfe prepared a list and arranged for its publication as a complimentary advertising booklet by one of the largest advertisers in the company's regular directory. In this way, an authorized list was published without cost to the telephone company and without the trouble that might have been caused by an unauthorized list. If such a numerical index is to be published at all, it should be published with the authority of the telephone company, and the plan adopted by Mr. Rolfe seems a practical solution of the method of publication.

BUT THEY'RE PRETTY GOOD FELLOWS, AT THAT

TELEPHONE ENGINEER:

In a small town in southwest Arkansas, where everyone knows one another and they all go to church and Sunday school, the owner of an Independent telephone exchange needed a lineman, so he inserted the following advertisement in the local newspaper:

"Wanted, a telephone lineman; must be honest, sober and a Christian gentleman; must be a first-class, hard-working telephone man with no bad habits. No others need apply."

He got the following answer: "Dear Sir: In reply to your ad for a lineman, as per your description, I want to say that I have been in the game for thirty years and know there ain't no such lineman. There was a carpenter something over 1900 years ago who filled that description, but he did not live long, for they crucified him. Since then I have never heard of any craftsman that came anyways near filling this description."—J. P. Whitson, Hope, Ark.

BE CAREFUL; IT'S ACCIDENT TIME

Statistics compiled by safety departments of telephone companies indicate that the season of the greatest number of accidents and personal injuries among the outside plant forces is the spring and early summer. Several reasons are advanced for this: expansion of construction activities, increased number of inexperienced men and other reasons. Whatever may be the causes, it is certain that more accidents do occur at this time of year, and it should become a time of special activity in accident prevention work. Attention has been called several times to the necessity of constant effort to keep the workmen in the habit of following safe practices. Consequently the repetition of material which has been used in previous years, while ostensibly for benefit of the new men, will also benefit the older men by bringing the matter again to their attention.

"THAT GANG OF MINE"

They are not sightly to the eye, from a dress standpoint or looks, they can cuss as much, if not more, than any other bunch of men; they can start more arguments during the noon period than any other bunch of men in the city; they can grouch more than the biggest bunch of pessimists in Michigan.

Yet, during working hours, they are 100 per cent on the job, and it is loyal service, willingly given to our company, to our superintendent, to our supervisor and to the foreman directly over them. In other words, they are co-operation personified.

They are only linemen and "grunts," but they are my gang. So why should I worry?—A. W. Viers, Line Foreman, Detroit, in "The Mouthpiece."

U. S. Telephone Increase, 1917-1922, 22.4%; Population 7%

Washington, D. C.—Number of telephones in use in the United States increased from 11,716,520 on Dec. 31, 1917, to 14,347,395 on the same date in 1922. Statistics made public by the Department of Commerce also disclosed that the rate of increase was 22.4 per cent, while the population was increased at a rate of about 7 per cent.

Greatest sectional gains were reported from New England and the middle Atlantic states, which comprise New York, New Jersey and Pennsylvania, their combined increase for the five-year period being at the rate of 34.6 per cent, compared with 17.6 per cent for the remainder of the country.

Florida, with 62.5 per cent, established the highest rate of increase for a single state, and New Jersey was second with 50.7 per cent.

Automatic Telephone Increase in Germany

The Siemens & Halske report for 1923 observes a heavy demand in Germany for automatic telephone instruments and systems. Altogether, more than 600,000 instruments were sold, and 150 switchboards and systems were installed in 72 German and 30 foreign cities.

Red Devil Tools — Better Made

"Red Devil" Linemen's Tool Belts

Combine Safety with Utility

"RED DEVIL" Tool Belts afford a high safety factor and minimize the risks and hazards to linemen engaged in telephone, telegraph and general power line construction.

Linemen's Tool Belt No. 458

Specifications

Made of selected heavy black oak tanned leather. It has extra heavy D's and buckle and six loops—three 2 inch, two 3 inch and one 4 inch.

An extra length of leather is laid in across the back of this belt. The two ends of this piece are turned back smoothly through the D's for a distance of four inches and fastened securely by copper rivets and linen stitching. This puts two thicknesses of leather between the D's and against the strain. All loops are copper riveted and neatly scored.

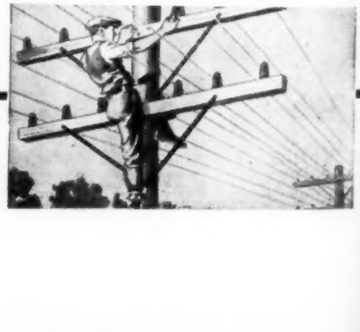
PRICES AND WIDTHS
Each

2 "—$3.00; 2¼"—$3.25
2½"— 3.75; 3 "— 5.50

At dealers everywhere—or if not in stock, send dealers name and order from us.

Send for the "Red Devil" Electrician's Tool Booklet

SMITH & HEMENWAY CO., Inc.
Mfrs. of "Red Devil" Tools
Dept. TE
261 Broadway, New York, N. Y.



TRADE MARK

EVER-PROTECT CABLE COMPOUND

has brought the economies of underground construction within the reach of every telephone company!

Notice how underground cable construction has greatly increased among the medium sized and smaller companies since they got word of the larger companies' success and savings with EVER-PROTECT?

Right now there's no reason why any company with cable distribution shouldn't lay cable underground, for the use of EVER-PROTECT gives them a simple, inexpensive and thoroughly satisfactory installation.

Cable laid underground with EVER-PROTECT is waterproof, perfectly insulated, and protected against chemical action and electrolysis.

The border illustration on this page shows how easy it is to use EVER-PROTECT for underground work.

Overhead, too, EVER-PROTECT is being widely used by hundreds of telephone companies. For coating messengers across railroad tracks or in factory districts, coating for crystallized or checked cable, and on the roofs of poles, in gains, and in woodpecker holes, EVER-PROTECT is proving a thrifty and effective preventative of trouble and expense.

Get complete details of EVER-PROTECT from your jobber or from us quickly so you can begin banking the money that EVER-PROTECT saves for you.

TARRED FELT PAPER ON DIRT FROM TRENCH
CABLE
TAR PAPER COATED WITH EVER-PROTECT CABLE COMPOUND
TRENCH
PLACING CABLE ON PAPER AND EVER-PROTECT CABLE COMPOUND AFTER CABLE COMPOUND BECOMES COOL
COATING CABLE WITH EVER-PROTECT CABLE COMPOUND
FOLDING PAPER AROUND COATED CABLE
FINISH
FILLING TRENCH
PLACING CABLE IN TRENCH
COVER WITH 3" DIRT UNTIL COOL

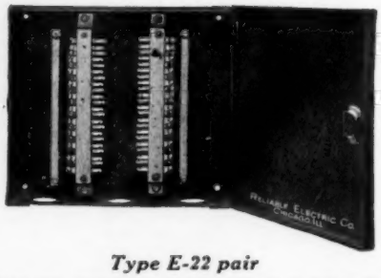
NATIONAL CABLE COMPOUND CO.

INCORPORATED

MITCHELL, INDIANA

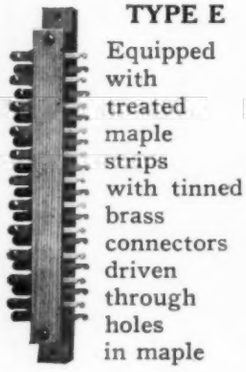
Steel Building Boxes For Telephone Distribution

ALL SIZES UP TO 200 PAIRS



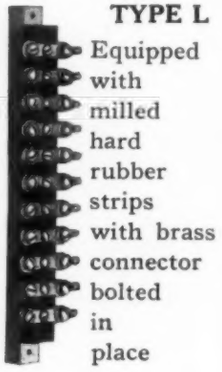
Type E-22 pair

CABLE WIRES SOLDERED



TYPE E

Equipped with treated maple strips with tinned brass connectors driven through holes in maple



TYPE L

Equipped with milled hard rubber strips with brass connector bolted in place

Telephone Wires Under Binding Posts

Neat—Compact—Accessible

The neatest little terminal for Office and Apartment Buildings

Before your next installation write us

Reliable Electric Company

3145 CARROLL AVENUE
CHICAGO, U. S. A

"COPPERWELD" TELEPHONE WIRE

TRADE MARK REG. U.S. PAT. OFF.

MADE BY THE MOLTEN WELDING PROCESS

Where No. 10 Hard-Drawn Copper or No. 12 BB Galvanized Iron is used a No. 12 Copperweld Telephone Wire will save you 70 pounds excess weight of wire per mile

	Diam.	Breaking Weight	Weight per Mile	Relative Factor of Safety: With ½" Ice and 8 lb. Wind Pressure	Relative Factor of Safety: With 15 lb. Wind Pressure, No Ice.
10 B&S hard-drawn Copper.....	.102"	528 lb.	166 lb.	98%	80%
12 BWG BB Galvanized Iron.....	.109"	476 lb.	170 lb.	88%	68%
12 B&S Copperweld	.081"	520 lb.	96 lb.	100%	100%

Copperweld wire does not rust. It stays up under sleet loads and wind pressure when other wires would be wrecked.

COPPERWELD COSTS LEAST PER YEAR OF SERVICE

Information and Wire Tables on request. **Copperweld, Braddock P. O., Rankin, Pa.**

Bell Company Leads Steel in Stock Output

New York, N. Y.—As directors of the American T. and T. Co. voted to offer to the company's present stockholders an additional $150,000,000 of the company's capital stock, the Bell company total outstanding capital stock was raised to $898,398,000, and passed that of the U. S. Steel Corp. with a stock capitalization including common and preferred of $868,583,600.

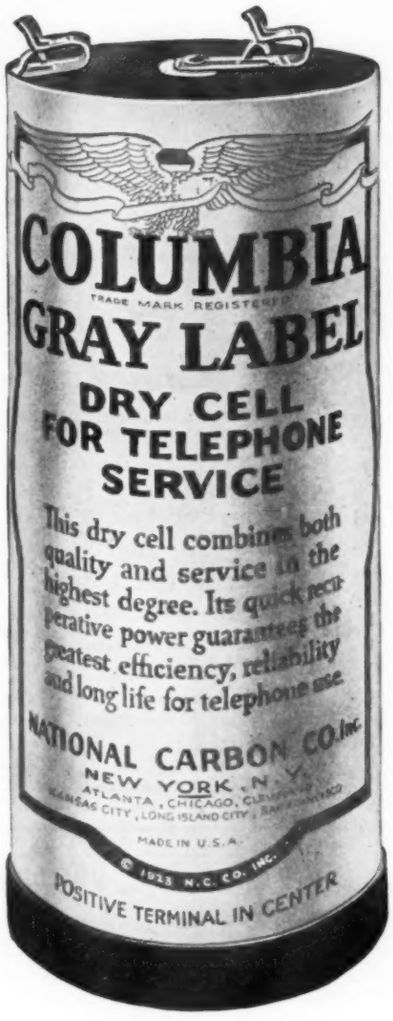
The new financing, according to H. B. Thayer, the president, has been made necessary by the increase in business during 1923, the largest of any year in the A. T. and T. company's history.

The funds provided through the sale of the new shares will be used in carrying out a comprehensive program of extensions in the nation-wide telephone service. More than 300,000 shareholders, with an average investment in the company of $500, will share in the rights to subscribe at par to the new stock, which is offered one share to every five held.

Fayette, Ky.—Addition costing approximately $55,000 is being made to the office of the Fayette Home Telephone Co.

Japan Places Large Telephone Order with Western Electric

The International Western Electric Co. has been advised by its associates, the Nippon Electric Co. of Tokyo, that the latter has received orders from the Japanese Government for automatic telephone central office apparatus to the value of $3,500,000. This comprises complete equipment for five offices, to serve 25,000 subscribers' lines, and replaces manually operated central offices destroyed in the recent disaster. The equipment is of the so-called "step-by-step" automatic type.


COLUMBIA
TRADE MARK REGISTERED
GRAY LABEL
DRY CELL
FOR TELEPHONE
SERVICE
This dry cell combines both quality and service in the highest degree. Its quick recuperative power guarantees the greatest efficiency, reliability and long life for telephone use.
NATIONAL CARBON CO. Inc.
NEW YORK, N. Y.
ATLANTA, CHICAGO, CLEVELAND
KANSAS CITY, LONG ISLAND CITY, SAN FRANCISCO
MADE IN U.S.A.
© 1923 N.C. CO. INC.
POSITIVE TERMINAL IN CENTER

"HOW doth the busy battery improve each idle hour?" Ask that question every time you buy telephone cells, for upon the answer depends battery economy and the satisfaction of the service.

Columbia Gray Label Batteries improve themselves in their spare time, recuperating their strength. And if the idleness is prolonged, it's all the same to them. They don't swell with anger at being shelved, nor bite their backs through nervousness. Quiet and efficient, they work or rest for months and months—they cost less per month of service. Fahnestock Spring Clip Binding Posts at no extra cost to you.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

Columbia Telephone Batteries

"less cost per month of service"

Northeastern Indiana Telephone Association Meets at Ft. Wayne

Fort Wayne, Ind.—Northeastern Indiana Telephone association's convention was attended by 150 officials and operators representing more than 35 telephone companies in the northeastern section of Indiana and the northwestern section of Ohio. The forenoon session was held jointly with the operators in the Fort Wayne Chamber of Commerce while an operators' get together meeting convened in the afternoon in the Assembly Room of The Home T. & T. company's main office.

"Standardization" was discussed at length by A. L. Staderman, telephone engineer and secretary of The Citizens Independent Telephone company, Terre Haute, who emphasized the great need of standardizing telephone equipment and operating, in order to economize in the operation of telephone plants and the furnishing of telephone service. He also told of the immense savings that could be made by all industries if standardization would be carried out universally. Mr. Staderman, who is a member of the American Engineering Standards committee, has been appointed by the United States Independent Telephone association as their representative in that body and is at present engaged in working out details of universal standards covering operating methods as well as equipment and materials used by the telephone industry.

Following Mr. Staderman, Miss Bertha Faut, Toll Chief Operator of The Indiana Bell Telephone company, Indianapolis, Indiana, talked on "Telephone Operating Problems." Referring to toll operating, Miss Faut said in part, "From a traffic viewpoint and as chief operators and supervisory employes we have one thought in mind, the giving of efficient toll service to the public. To me there is one essential to this success, namely, co-operation, for the giving of telephone service is a joint job and big results can be attained only by better and truer co-operation. Every office large and small has its important and particular duty to perform."

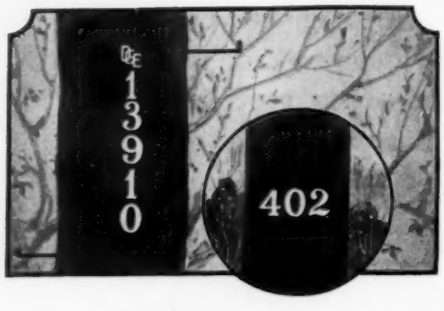
At the noonday luncheon meeting Henry A. Barnhart, president of The Indiana Telephone association, delivered the principal address in which, among others, he deplored the political unrest and denounced the sharp practices of political reformers in the stirring up of dissatisfaction and strife throughout the country which can only be detrimental to the welfare of the nation. Mr. Barnhart condemned the bloc method and the forming of opposing factions in the national government, declaring that men should be elected to office whose aims would be to serve all the people and not any particular section or class or bloc.

In our modern institutions of education and training the young men and women in crafts and domestic science, Mr. Barnhart saw a great help in enlightening the coming generation and educating them to be able to think before acting.

The afternoon session was opened by an address on telephone engineering and maintenance by H. E. Gray, General Plant Superintendent of The Home T. & T. company, of Fort Wayne, Indiana. Mr. Gray has had considerable experience in telephone engineering and has charge of the reconstruction work of The Home T. & T. company, which has been in progress for the past three years. He gave some figures and facts relating to the work which has already been accomplished in connection with the converting of the old overhead system of wires to one of underground cable and automatic telephone service.

B. C. Schweitzer, Commercial Agent of The Home T. & T. company, followed Mr. Gray with a very interesting talk on commercial problems. In his talk Mr. Schweitzer covered very completely the Order Routine followed by the "Home" company which is, however, also adaptable to companies of smaller size.

The result of the election of officers was the re-election of P. J. Maloney, Columbia City, Secretary of The Whitley County Telephone company, President; George John, General Manager of the Indiana Bell Telephone company, Huntington, Vice President, and Martin Umbach, Toll Commercial Superintendent of The Home T. & T. company, Fort Wayne, Indiana, Secretary-Treasurer.



Easily seen and weather proof

Our PREMAX Aluminum letters for pole-marking last the life of the pole. Can this be said of stencil-marking? Our distributor in one of the nation's greatest cities writes:—"The Telephone Co. informed me that they use your numerals for marking phantom transposition on the crossarms to indicate the type of transposition of wires that have been placed. They are used exclusively in place of stencils as stencils would not be clearly visible from the ground and would soon be effaced by the weather."

May we quote you on your requirements now?

NIAGARA METAL STAMPING CORP., Niagara Falls, N. Y.
Dept. G624

J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
J. G. Wray, Fellow A. I. E. E.
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Telephone Accountant
We make it our business to look after the interests of our telephone clients here in Washington. A high grade Federal Tax Service at a very reasonable price.
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Valuations—Supervision—Plant—Inductive Interference—Expert Administrative Counsel for Utilities
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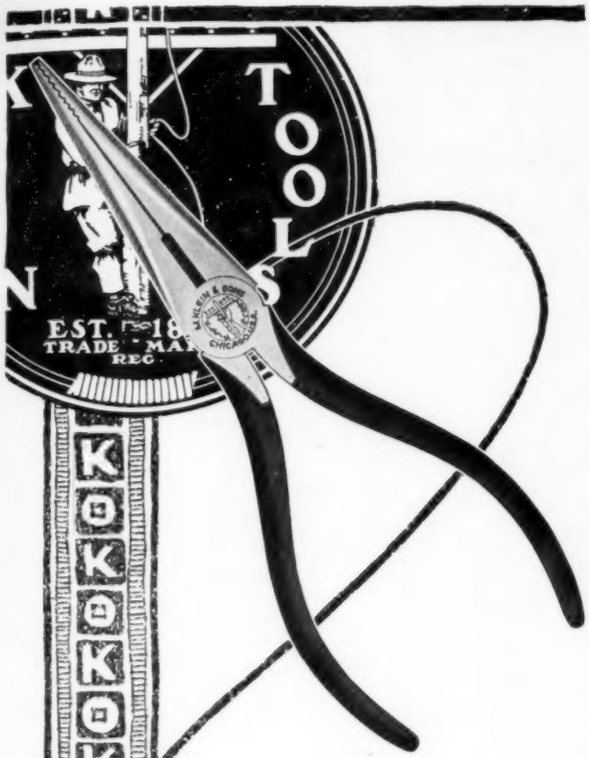
"Texas Black Beauty"
CREOSOTED POLES
Southern Yellow Pine—Straight, Full-Bodied—Pressure Treated Full Length—Safe Against Grass Fires—Decay Defying
TEXAS CREOSOTING CO., Orange, Texas, U. S. A.

Any telephone book printed may be purchased from the
BOOK DEPARTMENT *of*
TELEPHONE ENGINEER
28 East Jackson Boulevard CHICAGO



What other pliers can stand the game? What other pliers have the right spring and curve to the handles — just the right temper to the knives —just the fine materials and manufacture that you expect and get in a Klein plier!

Buy them for *your* linemen.

Mathias KLEIN & Sons
Established 1857 Chicago Ill USA

THOMAS · QUALITY — RELIABILITY

INSULATORS

In the Power and Lighting markets our product has successfully made our name the "buy word" in electrical porcelain.

Thomas Quality

defines a structure of porcelain that is hard, well fired, impervious to moisture and provides unparalleled strength mechanically. For well over a quarter century we have concentrated an expert force of engineering talent and exceptional plant facilities on the production of Insulators of the "superior" kind.

One branch of our business has been to maintain ample stocks of modern telephone insulators ready for the immediate call of the trade. Prompt shipments can be assured at all times, whether your requirements call for barrel or carload lots.

Your name entered on our mailing list will insure your receiving valuable literature as issued.

THE R. THOMAS & SONS CO.
EAST LIVERPOOL, OHIO
U. S. A.

NEW YORK CHICAGO BOSTON

Northern Electric Company
in Canada

Everstick

The standard anchor of companies whose engineering practice is standard for the industry.

Telephone companies of every size are using EVERSTICK Anchors because they are the best value in the world for holding hard and fast and for ease of installation.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

Ohio Telephone Construction Co.
R. E. THOMPSON, Manager
ADA, OHIO
Outside Plant and Underground Construction
Plant Engineering, Aerial and Underground Cable Construction (Burying of Cable), Switchboards, Main Frame and Power Boards and Clearing of Cable Troubles.
References, and List of Exchanges we have built, will be furnished on request.

Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
120-A, S. 7th St., Terre Haute, Ind.

KANIKSU CEDAR COMPANY
PRIEST RIVER, IDAHO

Western Red Cedar Poles
from the
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Butt Treating at our own Treating Plant

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Harry G. Holabird . . 451 E. 3rd St.
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STEPHENS CLIMBERS
Straps, Belts and Safetys
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FOR SALE We have on hand several hundred Equipoise Telephone Arms slightly used, but otherwise in good condition, which we are prepared to sell in large or small quantities at a considerable discount. Address Direct-Line Telephone Co., 450 Broome St., New York City.

POSITION WANTED
By all-around man, on magneto exchange. Well experienced. Will come on trial.
Address "E. D.," c/o TELEPHONE ENGINEER, 28 E. Jackson, Chicago

All Kinds of Printed Forms for Telephone Companies
Monthly Audits
General Accounting Systems Installed
Simplified Accounting for Small Companies
Every State in U. S. represented among our satisfied customers.
"Know where you stand"
Bowdle Accounting System
CERRO GORDO, ILL.

Get your
Telephone Repair Work
done at the old reliable
Telephone Repair Shop
SUTTLE EQUIPMENT CO.
OLNEY, ILLINOIS

$37.50 Addressograph
CHEAPER than typewriter—SAVES 20% of YOUR present costs — 5 to 15 times FASTER and BETTER than pen or typewriter.
FREE TRIAL will prove it!
Easy Pay'l Terms
901 W. Van Buren St., Chicago, Ill.

Tri-County Association Meets as Dayton's Guests

Dayton, O.—Approximately 200 members of the Tri-County Telephone Association were guests of the Ohio Bell Telephone Co., when the association held its May meeting. Besides officers of the 14 companies included in the association, which embraces Montgomery, Preble and Darke counties, the meeting was attended by operators and maintenance employes of 45 different offices.

W. C. Newton, division commercial superintendent, talked on "Commercial Service"; Walter Malloy, division traffic superintendent, talked on "Traffic Burdens" and J. W. Cherry, division plant superintendent, on "Plant Problems."

Following the three addresses, local operators demonstrated the operation of a "Smile exchange."

Builder of Dallas (Tex.) Plant Celebrates Ninetieth Birthday

Dallas, Tex.—Walter M. Clower, who opened the Dallas telephone system 43 years ago, recently celebrated his ninetieth birthday. The exchange opened with 40 subscribers. Dallas now has more than 50,000 telephones.

Chester, S. C.—P. M. Rogers and Raymond Rogers have bought the Pageland Telephone Co.

Argentina Tops South America in Telephones

Argentina ranks first in South America in telephone service, according to the national superintendent of telephones. Forty-two per cent of the telephone equipment in South America is in Argentina and the total line length represents fifty-one per cent of South America's total. Most of the telephones in Argentina are of English and American manufacture, a large percentage being made by an English branch of an American company. The service is concentrated in the provinces of Buenos Aires, Santa Fe, Cordoba, Entre Rios, Corrientes, Tucuman, and the Territory of La Pampa. There are 30,250 kilometers of general service line in Argentina, which, when added to the 640,150 kilometers used as private and railway lines, brings the grand total for the Republic to 670,150. Over seven hundred distinct localities are served. It requires seventy million Argentine pesos worth of equipment to carry out the needs of the service which, in turn, yields an annual gross revenue of seventeen million pesos and furnishes employment to six thousand nine hundred employees.